2016

SUMMER OUTLOOK & WINTER REVIEW 2015/2016

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1. Introduction

ENTSO-E and its member TSOs analyse potential risks to system adequacy that is the possibility for a power system to meet demand at all times and thus guarantee security of supply, for the 35 countries that are part of the network (including Turkey that joined ENTSO-E in 2015 as Observer member) plus Albania and the Burshtyn Island in Ukraine. The Burshtyn Island is covered in adequacy assessments as it is connected with the electrical system of continental Europe.

These analysis are done ahead of each critical season – that is seasons where weather conditions can be extreme and strain the system. ENTSO-E thus publishes before 1 June its Summer Outlook and before 1 December its Winter Outlook. Additionally ENTSO-E publishes an annual mid-term adequacy forecast – formally known as SOAF – that looks at system adequacy for the next decade. The MAF is put to public consultation in June and published in September.

Each seasonal outlook is accompanied by a review of what happened during the previous season. The Summer Outlooks are thus released with the Winter Reviews. The Winter Outlooks with the Summer Reviews. This allows for a check of what was forecast and what actually took place with regard of system adequacy.

The ENTSO-E system adequacy forecasts are presenting the views of the TSOs on risks to security of supply and also the countermeasures they plan, either individually or in cooperation with neighbouring TSOs.

Data is collected from TSOs and analysed using a common methodology based on high and internationally recognised standards in such exercises. For maximum accuracy ENTSO-E uses in its assessment the Pan-European Climate Database (PECD) to determine the level of solar and wind generation on a specific date and time.

ENTSO-E analyses the impact on system adequacy of climate conditions, planned outages, evolution of demand, demand management, evolution of generation capacities and system stability issues.

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In addition, an assessment of 'downward regulation'[1] issues is performed. Downward regulation is a technical term used when analysing the influence on the security of a power system when there is an excess in generation which cannot be reduced, typically when the wind is blowing at night when demand is really low or when the wind and sun generation are high but demand is not, for example a sunny Sunday.

The Summer Outlook analyses are performed by individual country, at pan-European level looking at how neighbouring TSOs can contribute to the power balance of a power system under strain. Finally, additional probabilistic analysis are performed for countries where a system adequacy risk has been identified.

They are done for each week between 1 June and 2 October 2016. The winter review looks at the system adequacy issues registered between 1 December 2015 and 3 April 2016.

The aim of publishing this forecast is two-fold:

1) It is to gather information from each TSO and share it within the community. This allows for neighbouring TSOs to consider actions to support a system which may be in difficulty. Also all TSOs share with one another the remedial actions they intend to take within their control areas. This information sharing contributes to increase security of supply and encourages cross-border cooperation.
2) The publication also informs stakeholders of potential risks to system adequacy. The goal is to raise awareness and hopefully incentivise stakeholders to adapt their actions to reduce these risks by for instance reviewing the maintenance schedules of power plants, the postponement in decommissioning and other risk preparedness actions.

ENTSO-E's seasonal outlooks are one of the associations's legal mandates under Article 8 of EC Regulation n. 714/2009.

[1] Assessment of potential generation excess under minimum demand conditions, cf. chapter 3.3.2

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2. Executive summary

The Summer Outlook 2016 @ a glance

The analysis performed by ENTSO-E shows that all considered Europe has sufficient generation to meet normal and severe demand conditions in the summer of 2016.

Various countries may have to rely on imports to cover demand but available cross-border capacities are expected to be sufficient in all conditions to accommodate them at the exception of Poland where security of supply might be at risk under severe conditions. Similarly, Great Britain might reach its maximum import capacity if severe conditions occur in the second half of September.

The decline in traditional net generation capacity continues. And as already identified in the Winter Outlook 2015/16, this decline is not compensated by the growth in net variable generation capacity.

Polish system adequacy still at risk

The risks to system adequacy in Poland that were already observed during the summer of 2015 could be repeated in 2016.

ENTSO-E's Summer Outlook 2016 identifies that during severe conditions, there is a risk that Polish import needs may exceed its available import capacity. In particular capacities on the synchronous profile[2] with Germany, the Czech Republic and Slovakia are significantly limited due to high unscheduled flows through Poland, from its Western border towards the South. These flows are the result of market transactions concluded outside of Poland and are very often causing a violation of the N-1 criteria[3], as proven on 15 September 2015 (N-1

[2] A profile is a geographical boundary between one bidding zone (area where electricity is traded without capacity allocation) and several neighbouring bidding zones. Synchronous means it is managed at the same time.

[3] N-1 is a European standard in transmission system operation by which the TSOs have to guarantee that their system will run safely even with one generator/asset down

not fulfilled for 4 hours). To decrease the risk of not fulfilling N-1 criteria[4], and to allow increasing commercial transmission capacities to Poland, PSE (the Polish TSO) and 50Hertz (one of the four German TSOs, from East Germany) agreed to exceptionally and temporarily disconnect one of the two interconnection lines between the two countries until it is upgraded to 380kV and equipped with a phase shifter[5].

This however is a temporary topological measure. It aims at mitigating the negative impact of unscheduled flows only, but it is not solving the origin of the problem of unscheduled flows. The sustainable solution, by means of structural market improvement (that is flow-based mechanism for coordination of capacity calculation in relevant regions with properly configured bidding zones), needs to be implemented as soon as possible. Since this sustainable solution cannot be implemented before 2018, **interim actions need to be developed in TSC, TSO Security Cooperation[6].**

Also Great Britain system might be constrained under severe conditions during the second half of September, notably in week 38. Indeed, the simulations during this week 38 show that Great Britain will have to rely on almost its maximum imports capacity. In extreme cases without wind and with low temperature, situation in Great Britain could potentially be very tight even with maximum imports from neighbour countries. However, such conditions have a very low probability of occurring, and even if they did occur, there are still several options available to meet demand. For instance, these may include using system operational reserves, a response from the market that could result in some imports from Irish interconnectors or generators shifting outages.

Evolution of generation capacity in Europe

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[4] N-1 is a European standard in transmission system operation by which the TSOs have to guarantee that their system will run safely even with one generator/asset down

[5] Common, PSE and 50Hertz press release: http://www.pse.pl/index.php?dzid=32&did=2908&lang_id=2

[6] TSC like Coreso is one of the Regional Service Coordinators, RSC, which will roll out in the whole of Europe by 2017.

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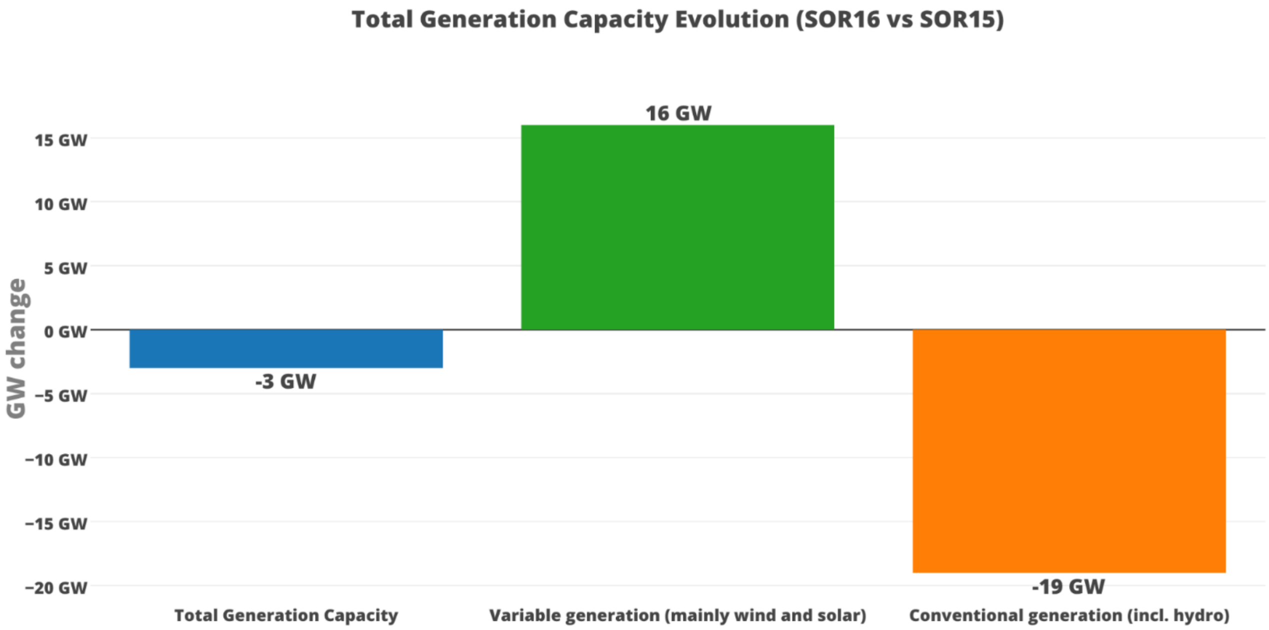
The trend of declining dispatchable[7] generation capacity in Europe, as mentioned in previous seasonal outlook reports, is continuing. On one hand, renewable installed capacities, mainly wind and photovoltaic, continue to grow strongly.

Compared to last summer, the global **net generating** capacity in Europe has even slightly decreased which seems to indicate that traditional generation units are being decommissioned at a faster rate than renewable energy sources are being installed.



**see footnote for details of data considered for this graph[8]*

Despite this, thanks to the highly interconnected European electricity network, the net importing[9] regions will be able to import from neighbouring countries. The European grid allows the necessary flexibility to transport the energy from generation to demand areas.

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[7] Dispatchable generation means generation plant that can be turned on and off or adjust their output at the request of the transmission system operator or the plant owner.

[8] It needs to be noted that the quoted quantities are net generating capacities; outages or the availability are not taken into account in the above graph. In particular wind/solar availability in hours per year, possible increased outage rate due to ageing of the conventional fleet, mothballing of gas plants due to market conditions, are not considered in the above figure 4, but are taken into account in the adequacy assessment,

Using the interconnection flexibility, installed demand side management and strategic reserve measures, the adequacy for the coming summer should be met for most European countries.

Result of the downward regulation assessment

In addition, throughout the summer period a ‘downward regulation’[10] assessment was performed to assess the constraints generated by an excess of renewable and non-dispatchable conventional generation when demand is low. This could occur typically on weekend nights (low demand combined with high wind) or on weekend days (limited demand combined with high photovoltaic generation and high wind).

The present report highlights that **during certain weeks over the summer period it may be necessary to export generation in excess to various countries**. Furthermore, in some countries it might even be required to reduce excess generation due to insufficient cross-border export capacity.

This later risk is limited to Germany and Belgium. Germany might be concerned - during daytime only - due to photovoltaic generation. Belgium might lack export capacity during some weeks in July and August, as its nuclear power availability is expected to be at its maximum in this period with a reduced availability of the pumping capacity. In some specific cases additional measures may be needed (for example modulation on nuclear units or optimisation of export capacity), in order to avoid curtailing the output of renewable energy sources.

[9] Net importing regions are regions that need to import electricity from other power systems to cover their demand in average

[10] Assessment of potential generation excess under minimum demand conditions, cf. chapter 3.3.2

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3. Methodology

3.1. A continuously improving 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 revisited adequacy assessment methodologies.

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

ENTSO-E published its *Target Methodology for adequacy assessment*[11] after a consultation period with the stakeholders, who acknowledged the proposed target methodology. The comments received mainly focused on the adequacy assessment methodology, assumptions, models to be implemented and the need for increased transparency. The Stakeholders' feedback on seasonal reports are critical and contribute to developing the methodology further.

3.2. Seasonal Outlooks reports are based on TSO expertise inputs

The coordination team that develops the Seasonal Outlook reports is composed of experienced experts from various TSOs all over Europe. At once, the analysis is based on data submitted by each TSO. For the present Seasonal Outlook both qualitative and quantitative data were submitted in March 2016 through a questionnaire. The report presents the TSOs' views on national and regional matters regarding the security of supply and/or inflexible generation surplus for the coming summer, including the possibility of neighbouring countries contributing to the generation/demand balance of each country in critical situations. The regional analysis is based on coordinated data which are submitted for several synchronous points in time.

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

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3.3. General adequacy approach

3.3.1. Upward adequacy analysis

The upward adequacy methodology consists of identifying the ability of generation to meet the demand by calculating the 'remaining capacity' under two scenarios:

'**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);

'**severe conditions**' correspond to extreme weather conditions 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).

The methodology is schematically depicted in the figure below[12]:

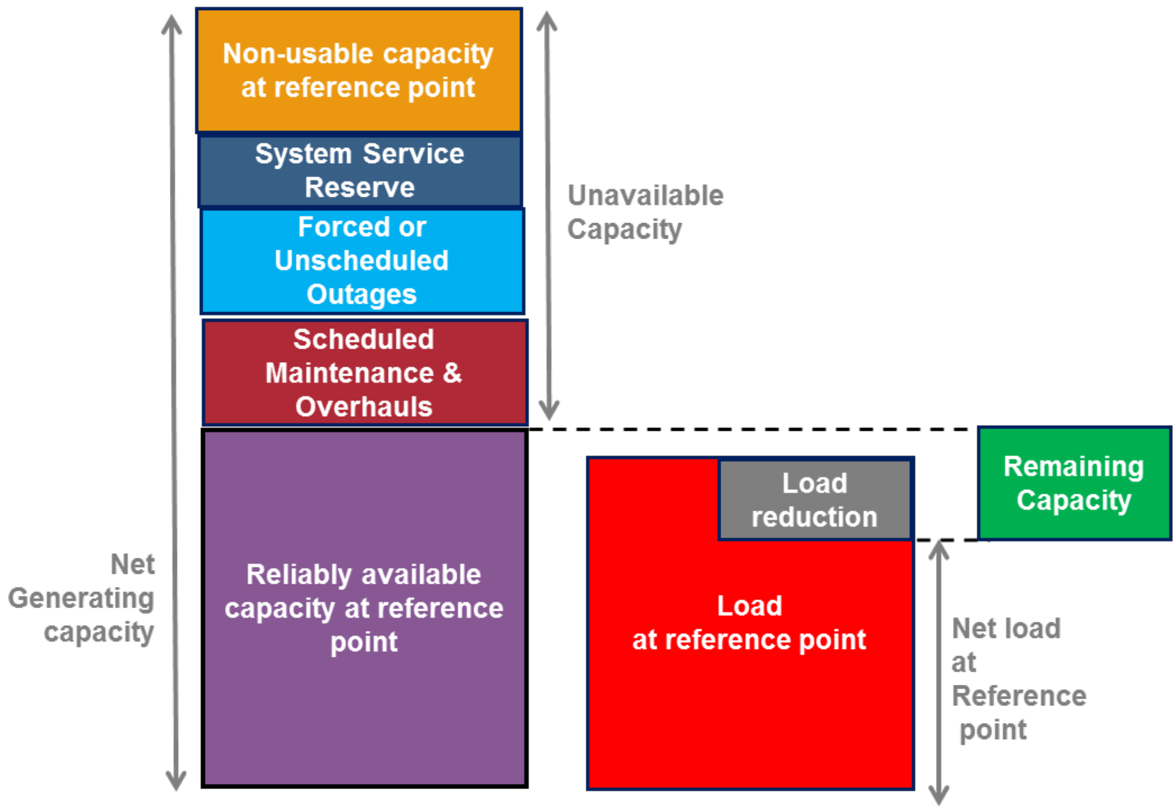

Figure 1: Upward adequacy methodology

[12] See Glossary for definitions in Appendix 5

The figures included in the per-country analysis show the 'Net Generating Capacity', the 'Reliably Available Capacity' and the 'Net Load' under normal and severe conditions. The remaining capacity is then calculated for normal and severe conditions.

The NTC values represent an ex-ante estimation of the seasonal transmission capacities of the joint interconnections on a border between neighbouring countries, assessed through security analyses based on the best estimation by TSOs of system and network conditions for the referred period.[13] All contributors were asked to provide a best estimate of minimum NTC values, being used as the basis for a worst-case analysis. When two neighbouring countries provided different NTC values on the same border, the lowest value was used. Additionally, for the regional analysis, simultaneous importable and exportable limits are considered to limit the global imports or exports of a country. These simultaneous limits were also reported by the contributors if applicable.

3.3.2. Downward adequacy analysis

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 is 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 methodology is schematically depicted in the figure below:

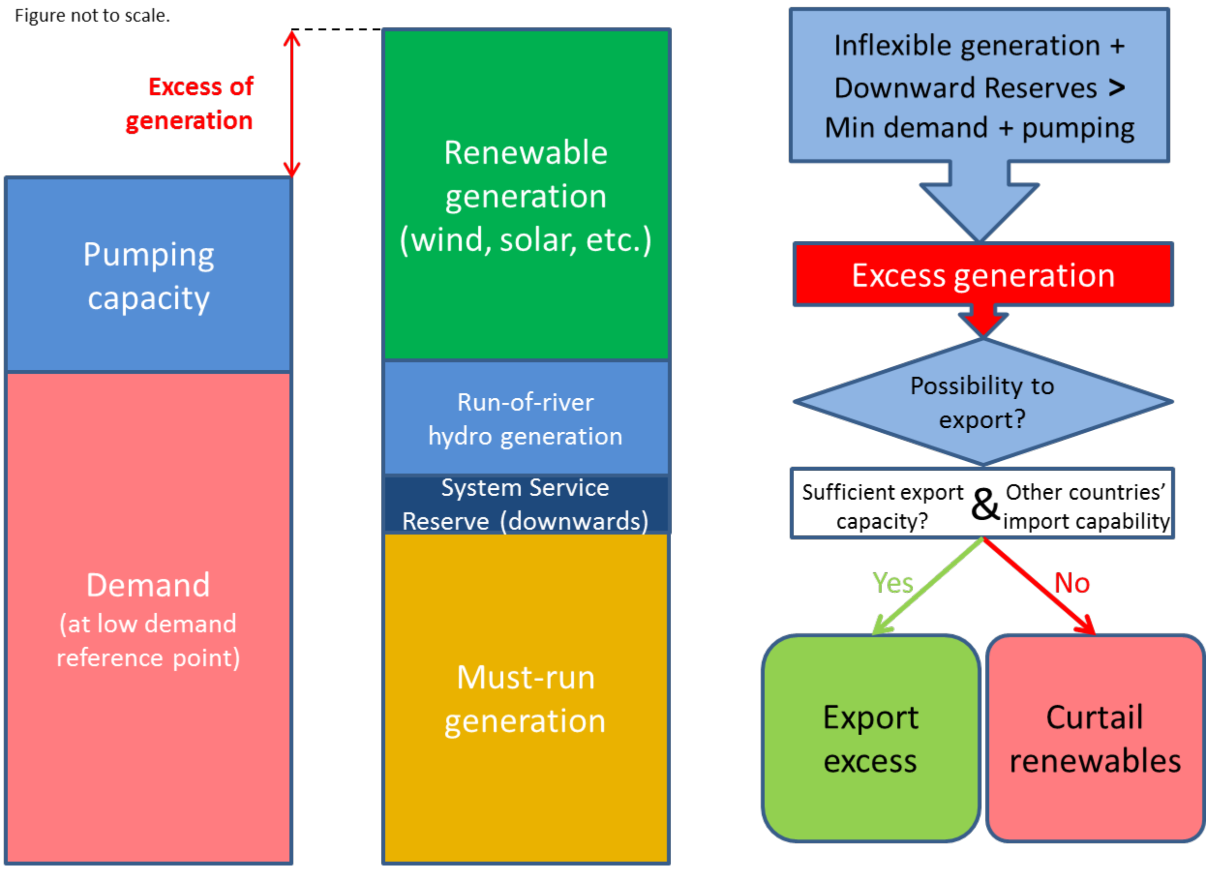

Figure 2: Downward adequacy methodology

For countries that have a generation excess, the optimisation in the regional analysis 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.

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.

3.4. Adequacy analyses

3.4.1. Regional analysis (upward and downward adequacy)

The regional analysis is based on a constrained linear optimisation problem[14]. The goal is to detect if problems could arise on a Pan-European scale due to a lack of available capacity (upward adequacy) and to 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 from which 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 regional analysis consists of several steps.

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.

For neighbouring systems of the study geographic perimeter that are not modelised in detail, like Morocco, Russia, Belarus, the Ukraine (except the Burshtyn Island, which operates

[14] Linear optimisation is a method to achieve the best outcome (such as maximum profit or lowest cost) using a mathematical model

synchronously with Continental Europe), the following values were assumed 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.

Besides the upward feasibility, a simplified merit order simulation approach has been also implemented in order to show which countries may be prone to import in a market perspective, even if they do not need import for adequacy reasons.

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

It is important to note that the merit order approach is a simplified approach which does not aim to predict the real market behaviour. Furthermore, the simplified hydro power

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modelisation using deterministic capacity-based assessments [MW] and merged modelling of reservoir and run-of-river hydro might not capture all specificities of countries with large share of hydro production (Norway, France, Switzerland, etc.).

3.4.2. 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.

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:

- As a starting point, the qualitative data provided by the TSOs for severe conditions is used;
- 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;
- The capacity factors for onshore wind, offshore wind and solar are replaced by those of the concerned record;
- 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.

3.5. Data processing

3.5.1. Synchronous points in time for regional analysis

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Several synchronous points in time are collected for all countries to allow for a meaningful regional analysis when determining the feasibility of cross-border flows. Ahead of the data collection, a study[15] was conducted using European historical load data to identify the most representative synchronous time points for the different analyses:

- Upward adequacy analysis - global European peak load in summer: Wednesday at 12:00 CET (Central Europe Time);
- Downward adequacy analysis - global European minimum load in summer: Sunday at 05:00 CET;
- Downward adequacy analysis – maximum solar panels generation combined with low load in summer: Sunday at 11:00 CET.

3.5.2. Renewables infeed data

For the upward adequacy analysis, the renewables infeed 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 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:

- 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;
- To achieve per country representative load factors for the generation adequacy analysis, the 50th (average conditions) and 10th (1 out of 10 situations) percentile of the 546 record collections are respectively calculated for normal and severe

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

conditions of the capacity factors per country and for solar, onshore wind and offshore wind separately.

As such, consistent Pan-European renewable infeed scenarios are created. For example, the 10th 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 infeed in all countries is simultaneously assumed to be equal to the 10th 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 infeed scenario if necessary.

For the downward adequacy 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.

3.5.3. Load scaling

The submitted per-country load data is collected under normal and severe conditions. 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 given the possibility to update the ENTSO-E proposed load sensitivity factors with their best estimate. An ENTSO-E dedicated Task Force was recently launched to improve further the load sensitivity factor data at pan-European level. This will increase consistency of the adequacy studies performed by ENTSO-E.

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).

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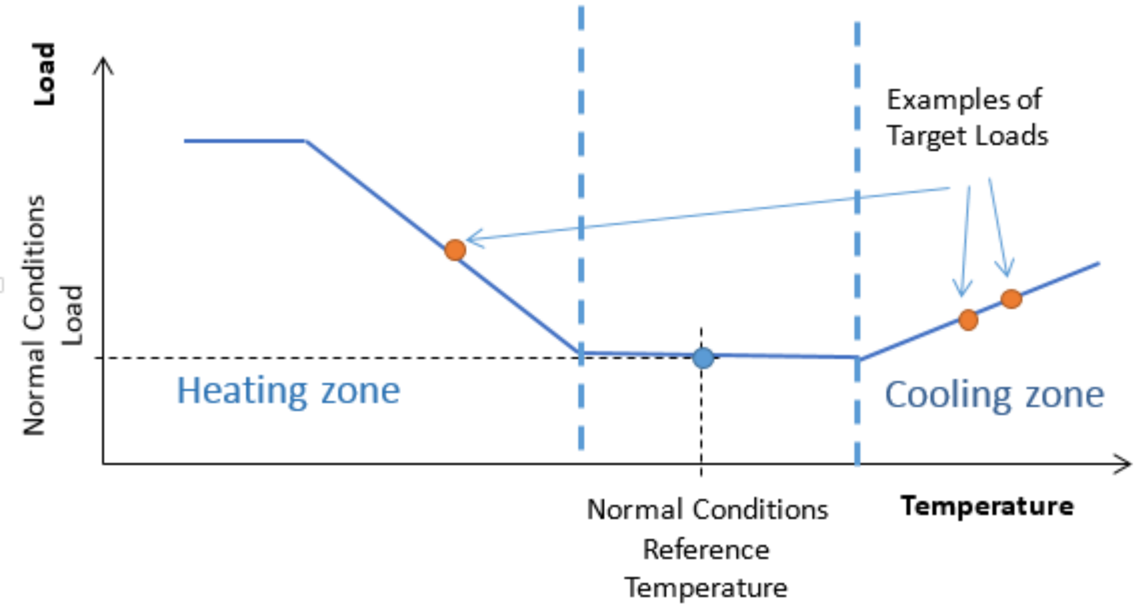

Figure 3: Load temperature sensitivity

4. Summer Outlook 2016

4.1. A context of decreasing flexible generation capacity

The analysis for the Summer Outlook 2016 confirms the trend of a decreasing of dispatchable generation capacity in Europe. Therefore the risks of adequacy tensions may appear more often in the future.

An illustration of the evolution of generation capacity throughout Europe is depicted in the figure below[16]. The capacity from dispatchable units have strongly decreased compared to last summer (-19 GW), while the Renewable Energy Sources (RES) capacity increased (+16 GW), causing the total Net Generation Capacity to decrease (-3 GW). In brief, this trend is showing that dispatch units are being decommissioned at a faster rate than Renewable Energy Sources are being installed.

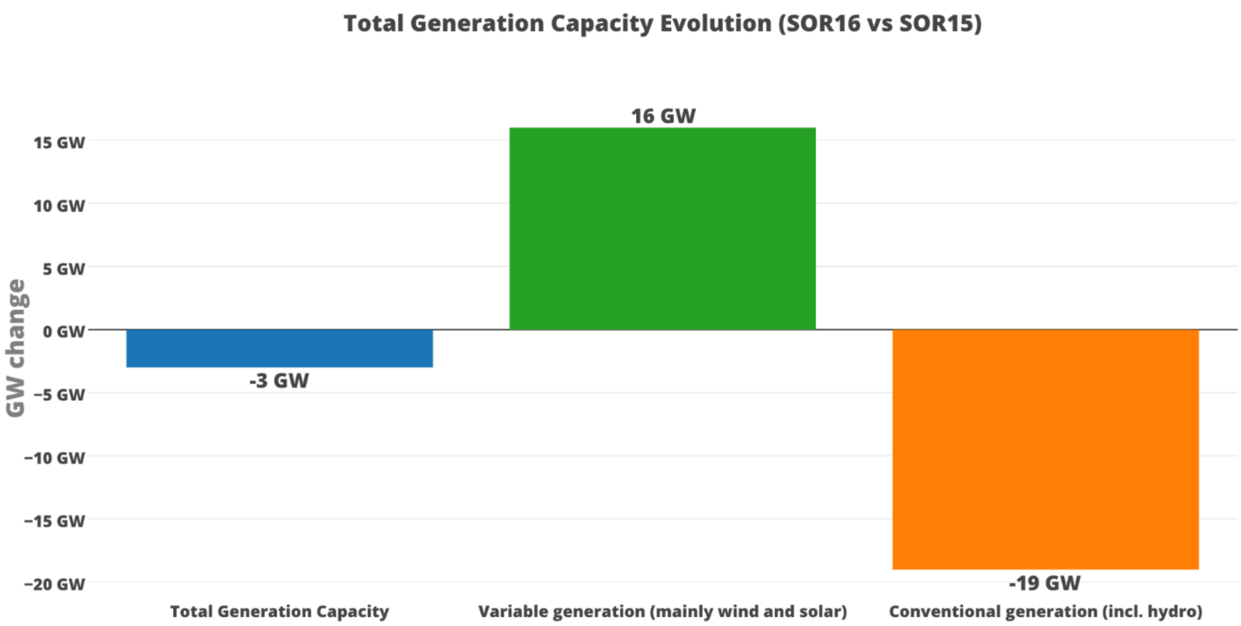

Figure 4: Net Generating Capacity evolution

[16] This comparison has been performed on the same perimeter as in the previous Summer Outlook report: Malta and Turkey, which have only been included starting from Winter Outlook 2015/16, are not included in this comparison.

It needs to be noted that the quoted quantities are net generating capacities; outages or the availability are not taken into account in the above graph. In particular wind/solar availability in hours per year, possible increased outage rate due to ageing of the conventional fleet, mothballing of gas plants due to market conditions, are not considered in the above Figure 4, but are taken into account in the adequacy assessment,

4.2. Main regional adequacy risks identified for the coming summer

The ENTSO-E Summer Outlook Analysis reveals that most countries in Europe would have sufficient generation in both normal and severe conditions. Several of them, though, 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 summer if severe conditions occur. In case of severe conditions indeed, there is a risk that Polish import needs may exceed its available import capacity. In particular, the import capacity 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. These flows are the result of market transactions concluded outside Poland and very often cause a violation of N-1 criteria, as proven on 15th September 2015 (n-1 not fulfilled for 4 hours). The optimum solution concerning unscheduled flows, is structural market improvement (i.e. flow based mechanism for coordination of capacity calculation in relevant region with properly configured bidding zones), which will not be implemented before 2018. In regards to possible generation shortage during severe conditions in the summer 2016, PSE has asked TSOs in the TSO Security Cooperation (TSC[17]) area to take interim 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. The interim actions as mentioned above have so far proven been insufficient for summer 2016. Regardless of the above actions within TSC, PSE in cooperation with 50Hertz analysed other bilateral measures possible for timely application, which could reduce

[17] The "TSO Security Cooperation" (TSC) is a cooperation initiative of eleven European Transmission System Operators (TSOs) to improve the security of the power grids throughout Central Europe. TSC is one of the Regional Service Coordinators, RSCs, that will cover all of Europe by end 2017. Other existing RSCs include Coreso in Brussels and SCC in Belgrade. Discussions on a Nordic RSC started in May 2016. See www.entsoe.eu for more information on RSCs.

negative impact of unscheduled flows on interconnected system security. The commissioning of the PST in Polish substation Mikułowa is planned in May 2016. This substation refers to Mikułowa-Hagenwerder line, which is one of two cross-border lines between Poland and Germany. In regards to this commissioning, PSE and 50Hertz agreed on the temporary disconnection of the Krajnik-Vierraden, second Polish-German interconnection. This network topology should allow for effective utilization of the PST in Mikułowa border substation. It will therefore allow for maintaining the secure operation of both transmission grids, even in situations causing so far high flows through the German-Polish interconnection and consequently high re-dispatch needs. In addition, steering the physical flow on the remaining Mikułowa-Hagenwerder line by PST operation is expected to allow for increasing commercial transmission capacities in the direction to Poland. Details can be found in PSE / 50Hertz press release: "Disconnection of Krajnik-Vierraden line". Nevertheless, solutions described above are still considered as a temporary measure only aiming to decrease the negative impact of unscheduled flows but not solving the origin of unscheduled flows problem.

Also, but to a lesser extent, the Great Britain system might be constrained under severe conditions during the second half of September, notably in week 38. Indeed, the simulations during this week 38 show that Great Britain will have to rely on almost maximum imports capacity from its neighbour countries.

4.3. Regional upward adequacy assessment

A regional assessment of the upward regulation was performed. For the generation adequacy analysis, infeed from wind and solar was calculated from the Pan-European Climate Database (Cf. section 3.5.2) to achieve a consistent scenario of renewable infeed over Europe.

It is important to emphasise that the scenarios evaluated in the regional assessment represent conditions that are significant to 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.

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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 1**.** It is also shown in Figure 5. **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:

	excess capacity
	deficit can be fully covered with imports
	25% of deficit cannot be covered with imports
	50% of deficit cannot be covered with imports
	75% of deficit cannot be covered with imports
	100% of deficit cannot be covered with imports

Table 1: Import needs at peak time under normal conditions

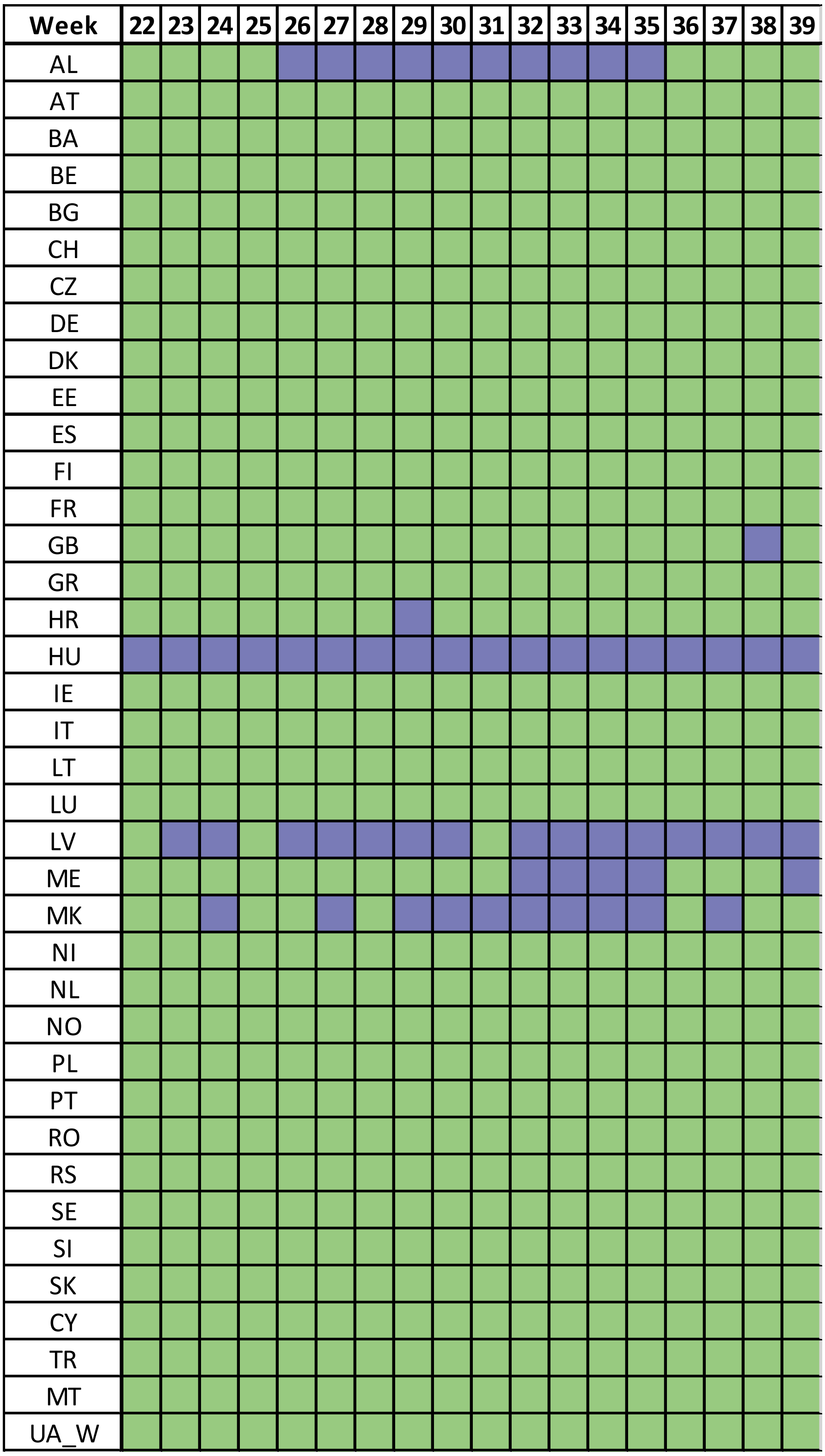
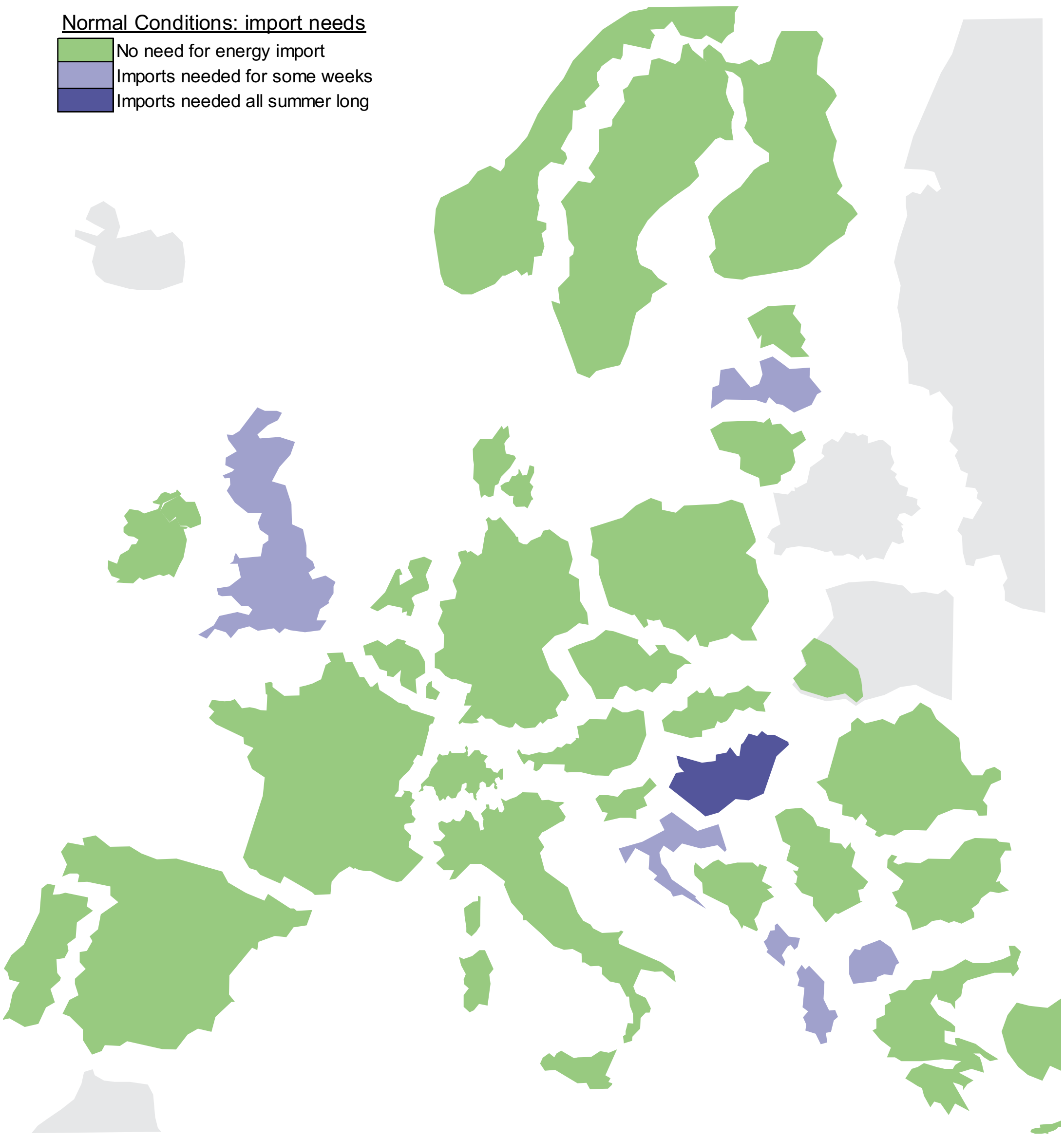


Figure 5: Generation adequacy map under normal conditions



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 the countries which 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 the countries which are prone to import from a market point of view for next summer under normal conditions. The 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 blue.

Figure 6 shows which countries are prone to such a market-based importing position for some or all weeks under normal conditions.

It is important to note that the merit order approach is an assumption and that the following Table 2 and Figure 6 may not represent the real market situations. Especially the current hydro power simplified modelisation with deterministic capacity-based assessments [MW] may not represent the market reality of countries with high penetration of reservoir hydro with natural feed-in (Norway, France, Switzerland, etc.).

Table 2: Countries prone to market-based imports at peak time under normal conditions

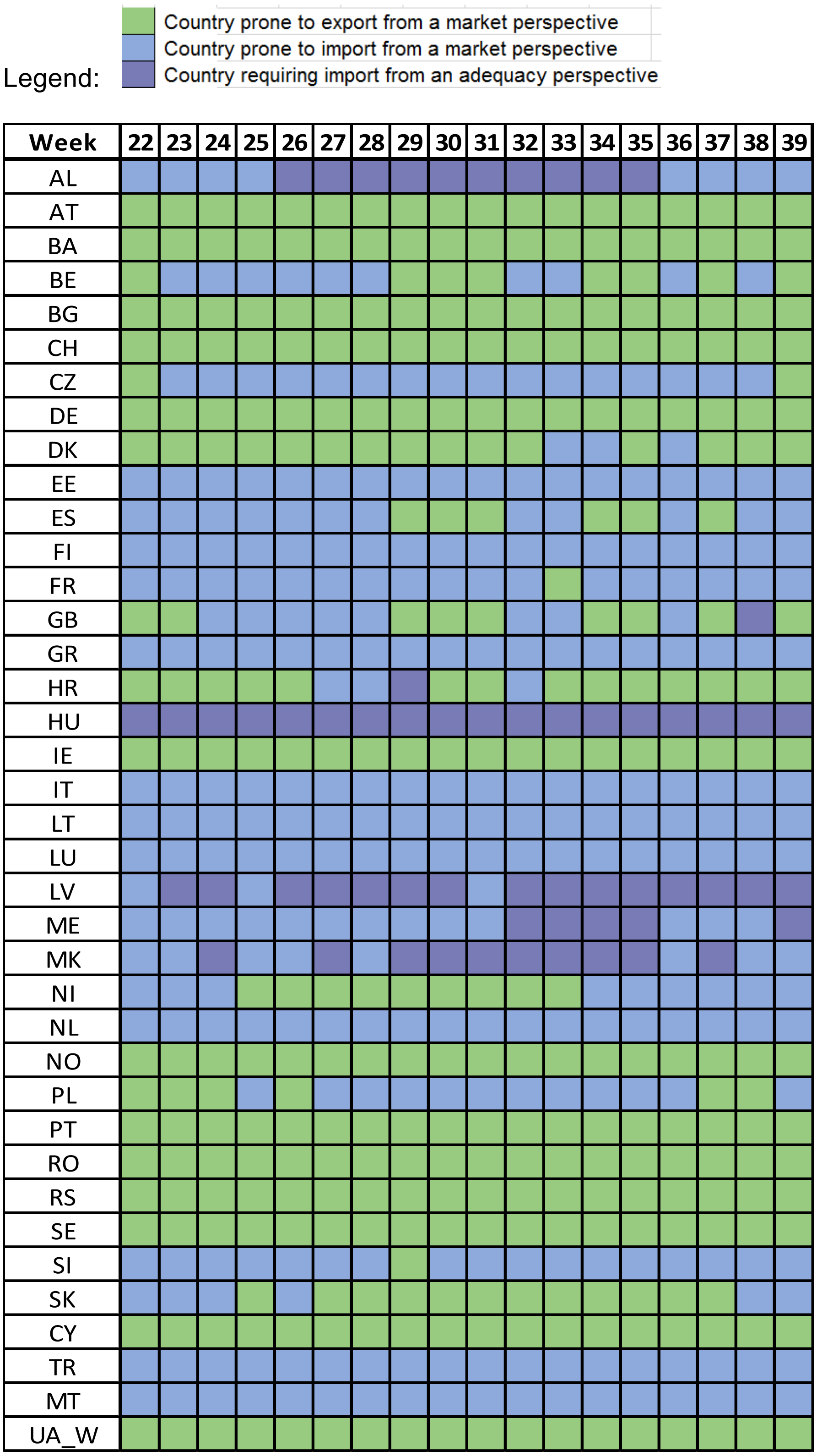
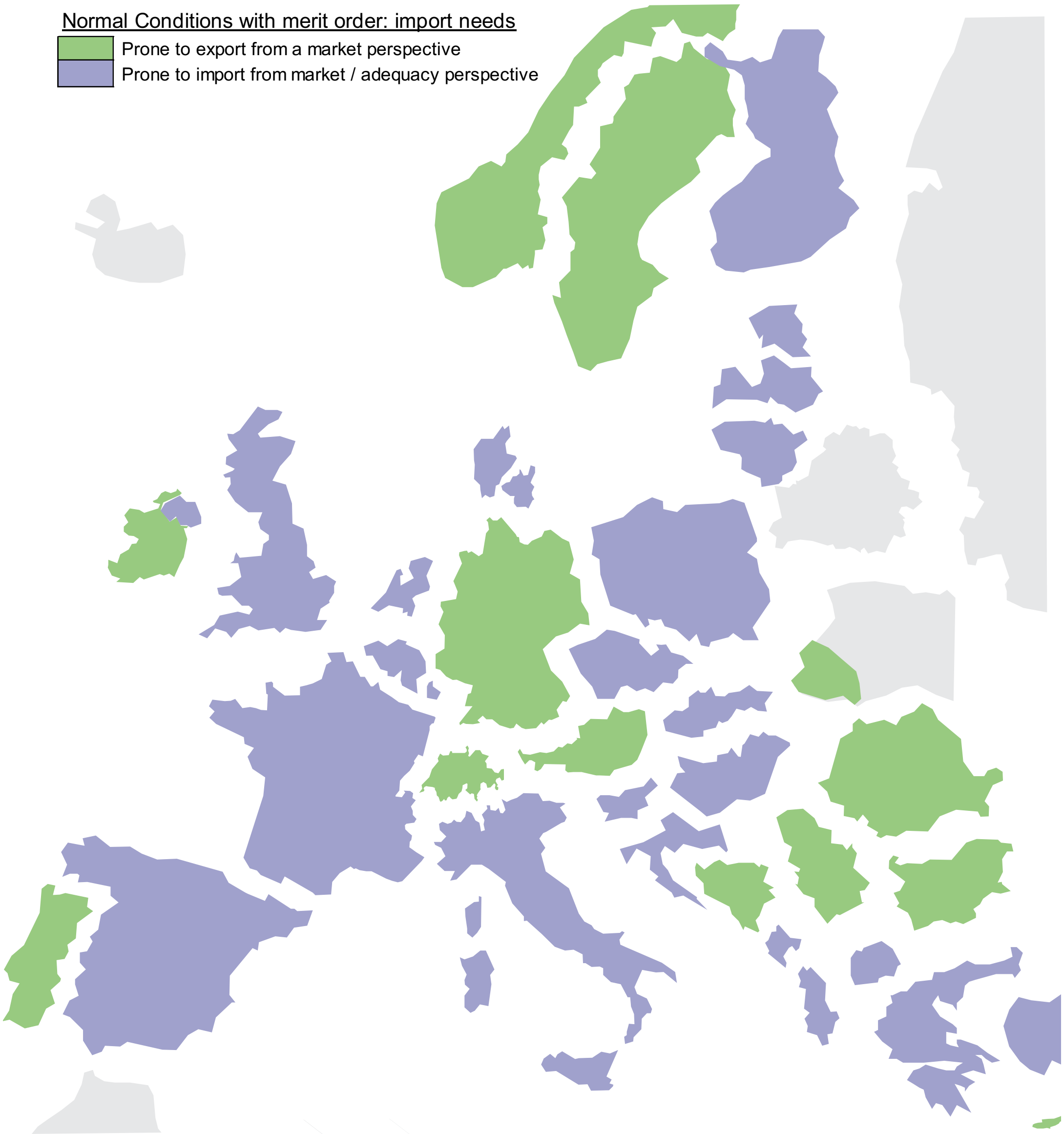


Figure 6: Estimated market-based imports at peak time under normal conditions



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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. **For these 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 has been identified for Poland in several weeks between June and August. The severe balancing conditions take place in case of long lasting heat wave leading to significant deterioration of Polish power system. This causes an increase of load with a simultaneous decrease of generating capacities due to the increase of non-usable capacity and a higher forced outage rate of generators. Wind generation is quite low at that time in summer and there is almost no solar generation, because level of solar installations is negligible. The growth of non-usable capacity mainly refers to hydrological constraints resulting from an extremely dry summer and autumn 2015 and its continuation into winter. Low water levels and warmer temperatures of rivers affect not only the output of hydro power plants, but mainly compromises the ability of the water to cool thermal generation plants effectively. Indeed, water temperature must not deviate too far above a normal temperature, as said deviations may lead to restrictions in the power output of thermal generation plants. All available cross-border capacities into Poland are saturated, and no import capacity is available on the common synchronous profile (with DE+CZ+SK). The unavailability of import capacity on this profile is due to congestion from unscheduled flows through Poland from its western border to its southern border as the result of market transactions concluded outside of Poland. To decrease the risk of not fulfilling N-1 criteria and to allow increasing commercial transmission capacities to Poland, PSE and 50Hertz agreed to exceptionally and temporarily disconnect the Krajnik-Vierraden line between the two countries. It allows effective steering of the physical flow on the remaining PL-DE Mikułowa-Hagenwerder line

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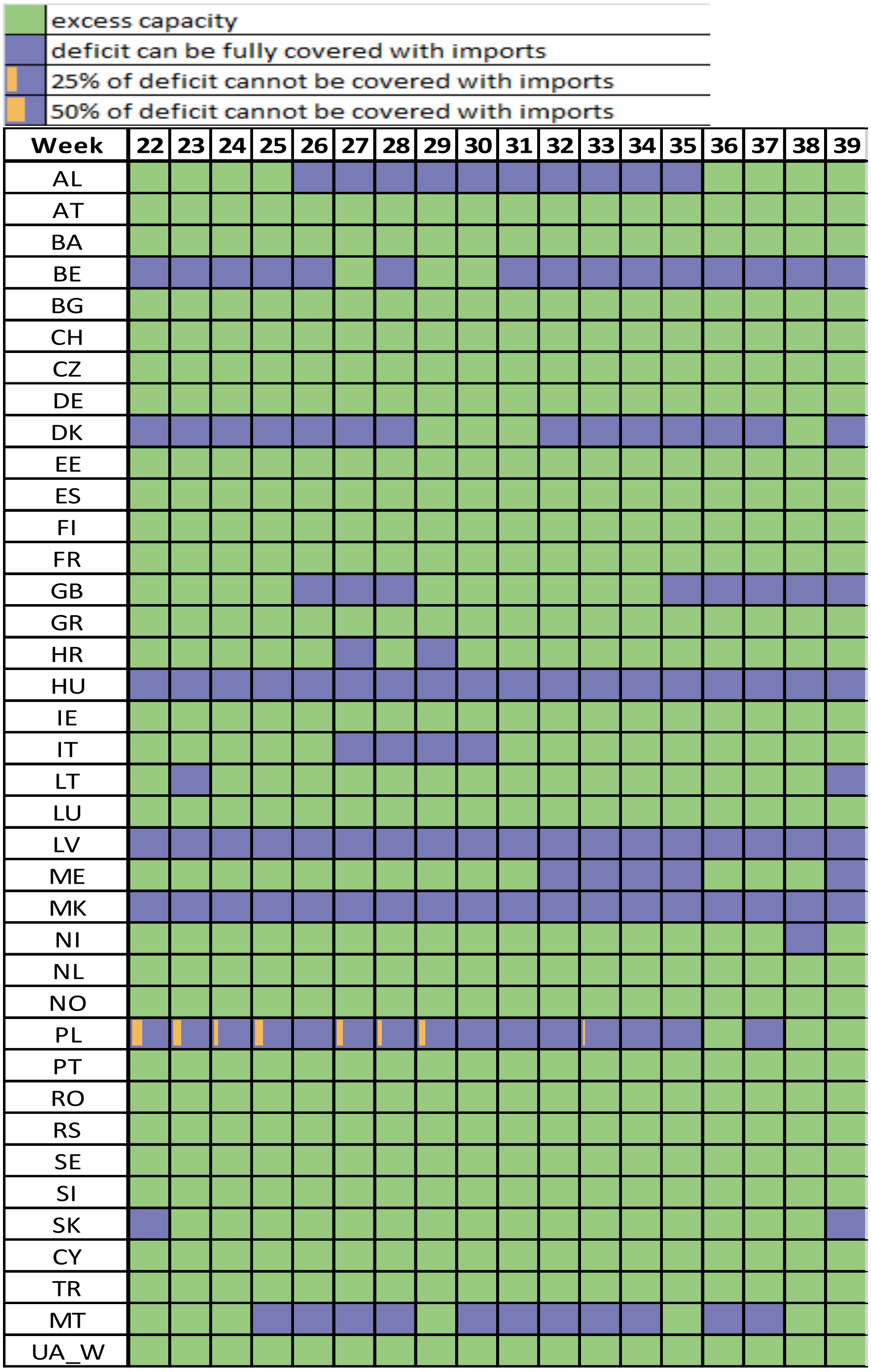
by PST operation (cf. press release[18]). For a more detailed appreciation of the expected situation in Poland, please refer to the Polish section in Appendix 1.

Table 3: Import needs at peak time under severe conditions

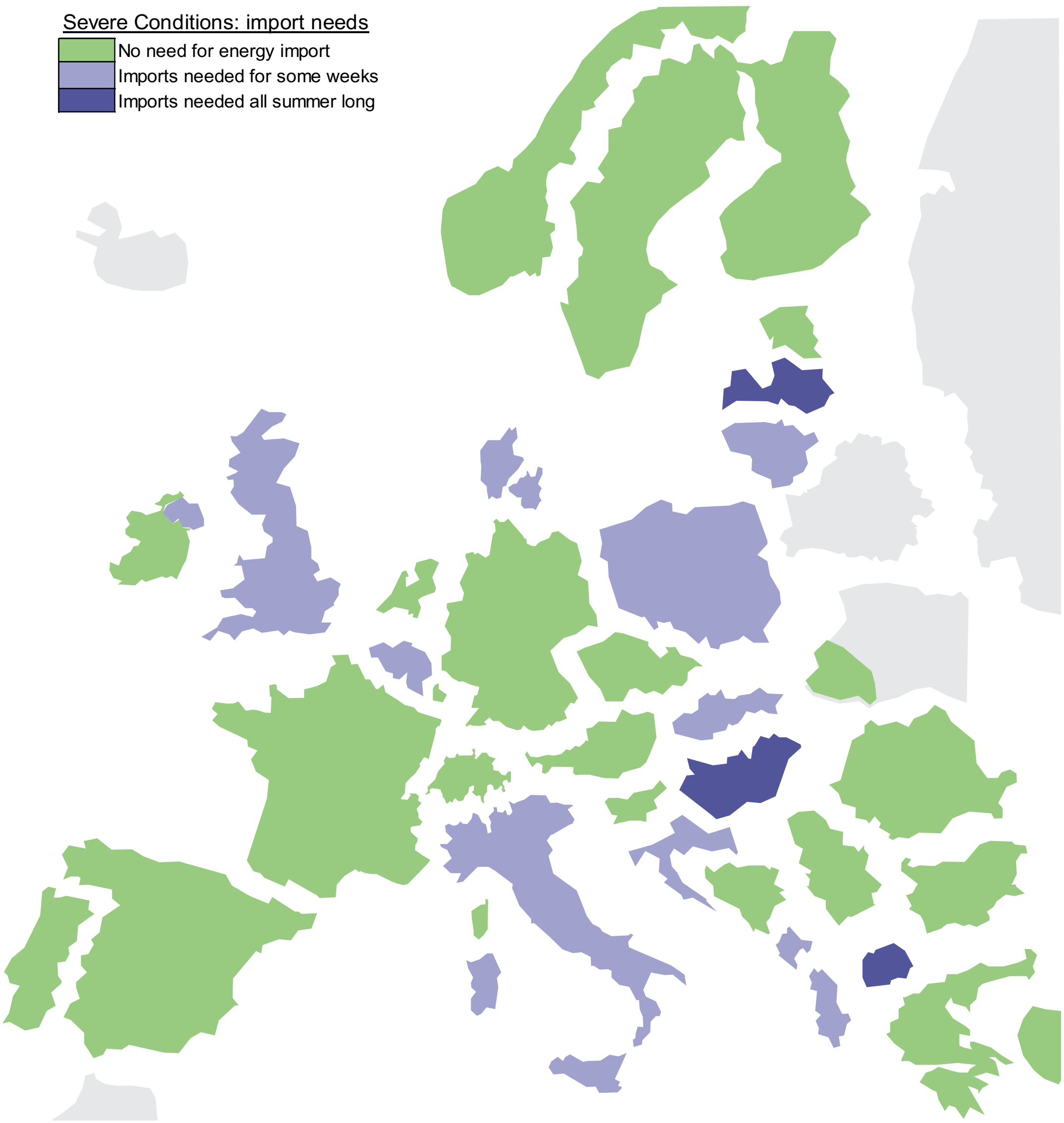


[18] http://www.pse.pl/index.php?dzid=32&did=2908&lang_id=2

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.

The beneath map show in particular that Latvia, Hungary and FYR of Macedonia will need to import all summer long at peak time under severe conditions. But the interconnection capacities of these three countries will be fully sufficient to reply to their needs.

Figure 7: Generation adequacy map at peak time under severe conditions



Simplified merit order approach

Using, the same approach as under normal conditions (cf. chapter 3 for methodology details), an estimation of countries prone to import was performed.

Table 4 shows which countries are prone to import from a market point of view for next summer under severe conditions. The 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 blue.

Figure 8 shows which countries are prone to such a market-based importing position for some or all weeks under severe conditions.

It is important to note that the merit order approach is an assumption and that the following Table 4 and Figure 8 may not represent the real market situations. Especially the current hydro power simplified modelisation with deterministic capacity-based assessments [MW] may not represent the market reality of countries with high penetration of reservoir hydro with natural feed-in (Norway, France, Switzerland, etc.).

Table 4: Countries prone to market-based imports peak time under severe conditions

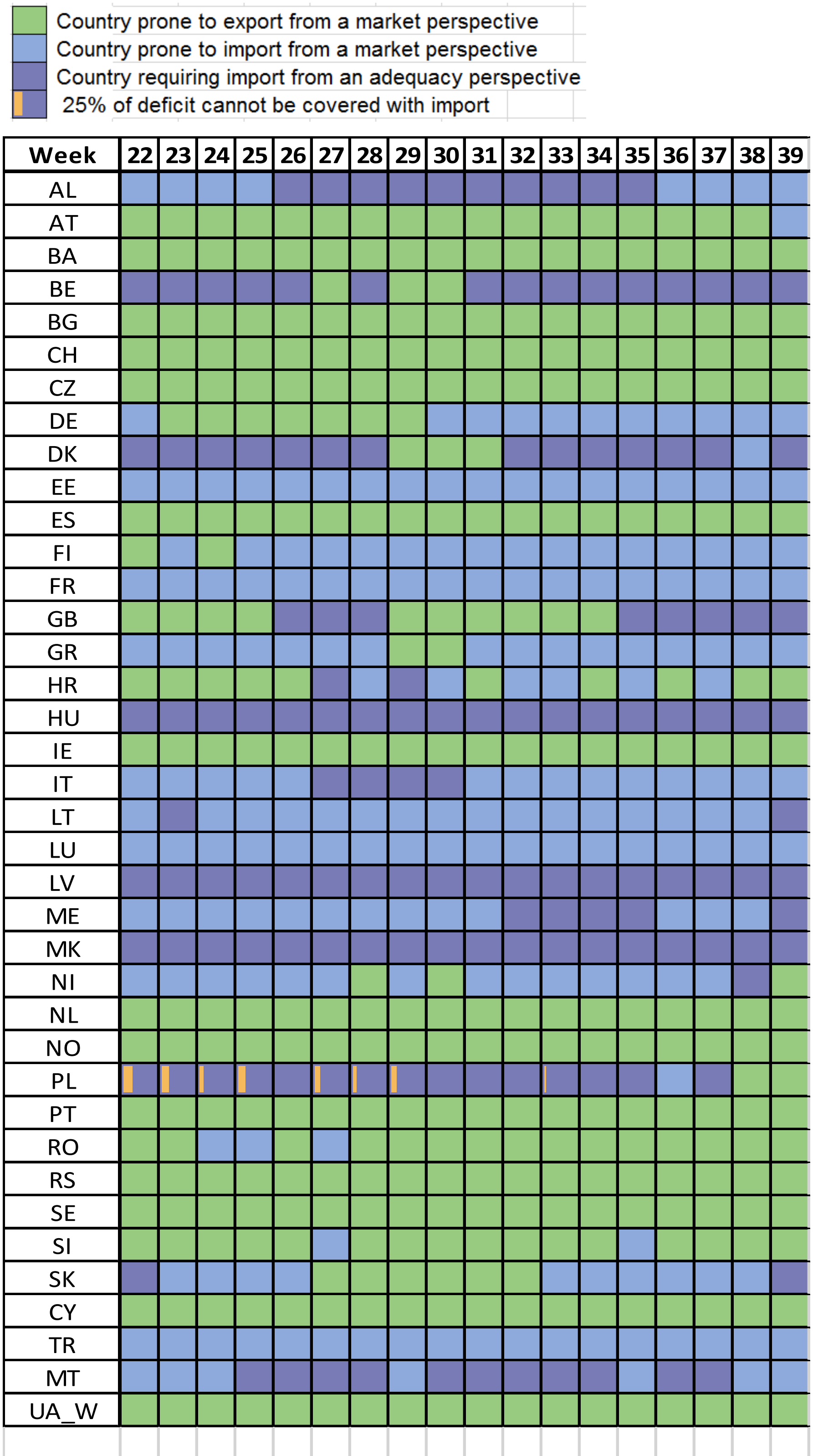
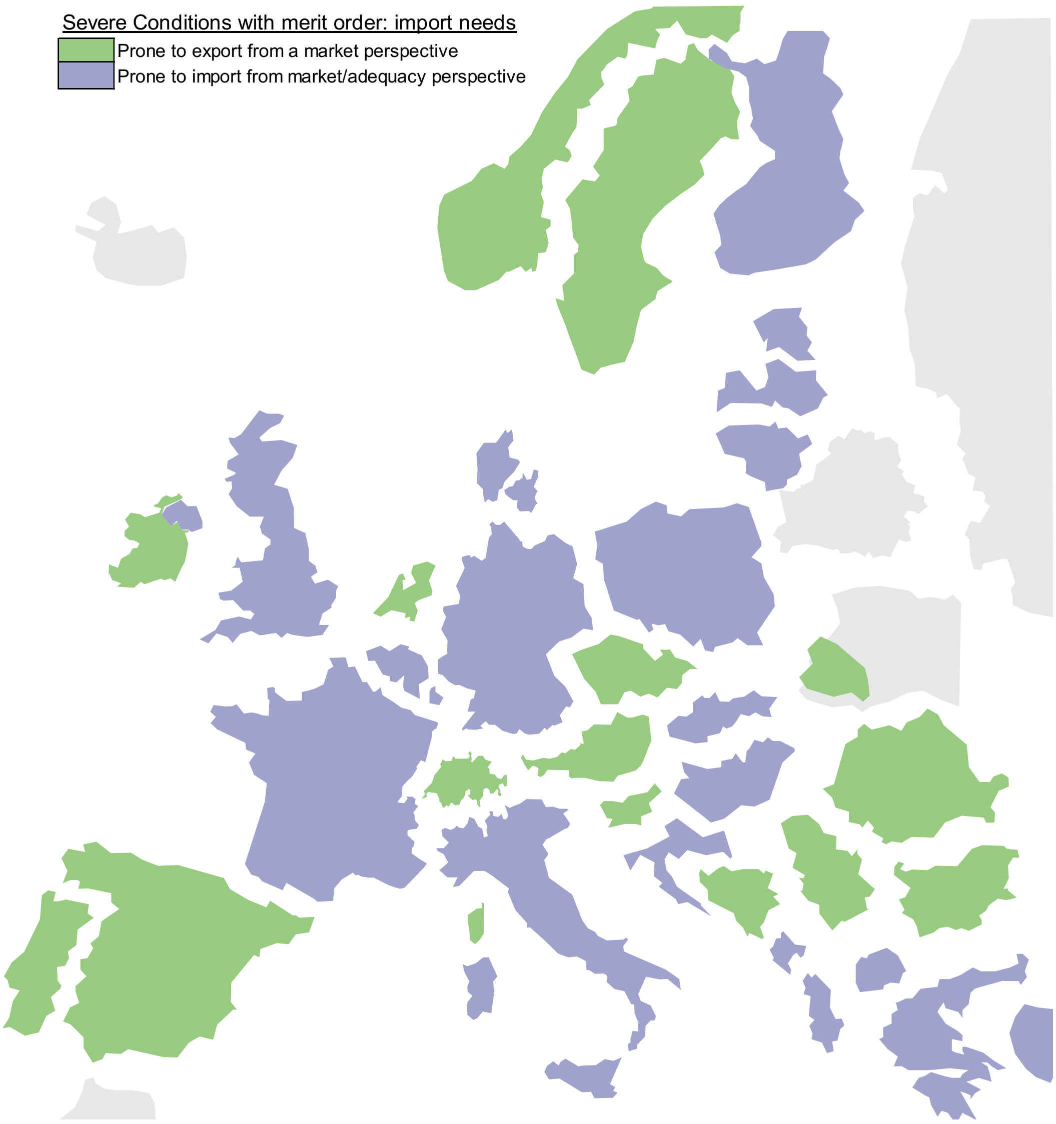


Figure 8: Estimated market-based imports peak time under severe conditions



4.4. Probabilistic sensitivity analysis for countries or regions at risk

The adequacy calculations under severe conditions (cf. previous chapter) show that Poland might not have enough import capacity to cover its demand during several weeks. For Poland, the critical situation is closely linked to a long lasting heat wave, when not only load increase is observed, but also the increase of non-usable capacity in thermal power plants.

This would indeed be a repetition of what happened in the year before (cf. Winter Outlook 2015/16 Report[19]). Hence calculating the probability even of very high temperature during few days would not be representative of a critical situation for Poland.

Also Great Britain system might be constrained under severe conditions during the second half of September, notably in week 38. Indeed, the simulations during this week 38 show that Great Britain will have to rely on almost maximum imports capacity from its neighbour countries.

To investigate the situation for Great Britain in more detail, further simulations have been carried out for the third week of September (week 38). 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 Great Britain.

Figure 9 shows the results, with the total weighted wind capacity factor on the horizontal axis, and the population weighted daily average temperature on the vertical axis. The scatter plot depicts the probability of following situations:

Green if no imports are needed for that simulation;

Blue if imports are sufficient to cover the demand;

Orange if imports (up to 3GW) cannot cover the demand and require more imports from other interconnectors and/or up to 3GW strategic reserves might have to be used;

Red if imports (more than 3GW) cannot cover the demand and require more imports from other interconnectors and/or up to 3GW strategic reserves and/or emergency *signal to market for extra capacities* measures might have to be used.

Figure 9: Probabilistic assessment of import needs for Great Britain for the situation investigated (Week 38)

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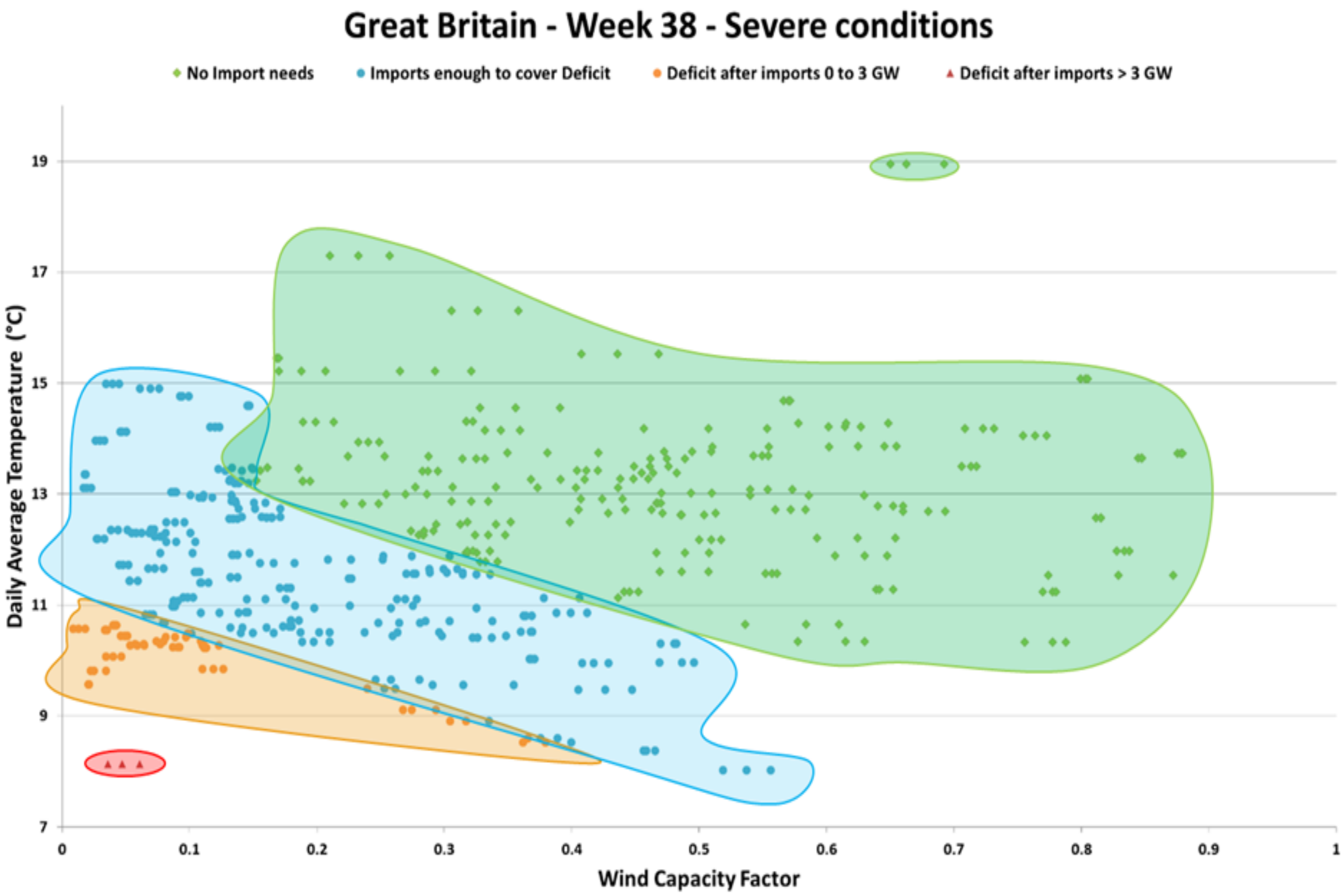
[19] https://www.entsoe.eu/Documents/Publications/SDC/Winter_Outlook_15-16-REPORT_web.pdf



Under **severe conditions**, the British TSO would require imports from France or the Netherlands to meet demand. In extreme cases (red dots in above chart), e.g. if wind is less than 6% and the temperature is less than 8 °C in September (i.e. week 38), then the situation could potentially be very tight even with maximum imports from France and the Netherlands. However, the probability of such weather conditions is **very low** (around 0.5%).

Even if such conditions were to occur, there are still several options available to meet demand. These include using some of the 3GW system operational reserve, which have been excluded from this assessment, but could be used to meet demand in real-time. We may also expect to see a response from the market that could result in some imports from Irish interconnectors, or generators shifting outages.

4.5. Downward regulation margins

With increasing renewable generation and in parallel decreasing dispatchable generation in Europe, the probability of encountering issues relating to an excess of inflexible generation

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also grows. During certain weeks it may be necessary to export excess inflexible generation in various countries. Furthermore, in some countries (Germany and Belgium) it might even be required to reduce excess generation (or other measures) as a result of insufficient cross-border export capability.

The downward regulation margins were calculated for both weekend nights (characterised by low load, high wind) or on weekend daytime with high photovoltaic generation.

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 4: Export needs at the daytime minimum

Key (colour)	Legend
N (green)	no generation excess (no need to export)
E (blue)	excess can be covered by export
P (blue with orange bar)	25% of excess cannot be covered by export
P (blue with orange bar)	50% of excess cannot be covered by export

Week	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
AL	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
AT	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
BA	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
BE	E	E	E	E	E	P	P	P	P	P	P	P	P	P	E	E	E	E
BG	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	N	E
CH	N	N	N	N	N	N	N	E	E	N	N	N	N	N	N	N	N	N
CZ	N	N	E	N	N	N	N	E	E	N	N	N	N	E	N	N	N	N
DE	P	P	P	P	P	P	P	P	P	P	P	P	P	P	E	E	E	E
DK	E	E	E	E	E	E	E	E	E	E	E	E	E	N	N	N	N	N
EE	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
ES	E	E	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
FI	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
FR	E	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
GB	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
GR	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
HR	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
HU	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
IE	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
IT	N	N	N	N	N	N	N	N	N	N	E	N	N	N	N	N	N	N
LT	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
LU	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
LV	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
ME	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
MK	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
NI	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
NL	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
NO	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
PL	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
PT	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
RO	E	N	E	E	N	E	N	N	N	N	N	N	E	E	E	N	E	N
RS	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SE	N	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
SI	E	E	E	E	N	N	N	E	E	E	E	E	N	E	E	E	E	N
SK	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
CY	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
TR	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
MT	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
UA_W	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

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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 Belgium a potential issue regarding excess inflexible generation might arise in several weeks.

The situation in Germany is caused by high amount of renewable, especially photovoltaic during the daytime.

In Belgium, the situation is mainly linked to the maximum availability of nuclear power (6 GW during July and August), as nuclear power is considered as "must run" in the assumptions for Belgium, in combination with a reduced availability of the pumping capacity. In some specific cases additional measures may be needed (for example modulation on nuclear units, optimisation of export capacity...), in order to avoid curtailing the output of renewable energy sources.

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Table 6: Export needs at the night-time minimum

N	no generation excess (no need to export)
E	excess can be covered by export
25%	25% of excess cannot be covered by export
50%	50% of excess cannot be covered by export

Week	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
AL	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
AT	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
BA	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
BE	N	N	N	N	N	E	E	E	E	50%	25%	E	E	E	N	N	N	N
BG	E	E	E	E	E	E	E	E	E	E	E	E	E	N	N	N	N	N
CH	E	N	N	N	N	E	E	E	E	N	N	N	N	N	N	N	N	N
CZ	N	E	E	N	N	N	N	E	E	N	N	N	N	N	N	N	N	N
DE	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
DK	E	E	E	N	N	E	N	N	E	E	E	E	E	N	N	N	N	N
EE	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
ES	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
FI	N	N	E	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
FR	E	E	E	N	E	N	N	N	N	N	E	N	N	N	N	N	N	N
GB	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
GR	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
HR	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
HU	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
IE	E	E	E	E	E	E	E	E	E	E	E	E	N	N	N	N	N	N
IT	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
LT	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
LU	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
LV	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
ME	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
MK	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
NI	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
NL	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
NO	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
PL	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
PT	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
RO	N	N	E	E	N	E	E	N	N	N	N	N	E	E	E	N	N	N
RS	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SE	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
SI	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SK	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
CY	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
TR	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
MT	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
UA_W	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

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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 Belgium, a potential issue regarding excess inflexible generation might arise. However, the risk would be significantly smaller compared to the daytime minimum scenario. For Germany the results of night-time minimum demand do not show a potential issue in opposition to daytime demand 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 countries that need to export energy are quite geographically distributed and are neighbour to importing countries. Thus, a low probability of potential issues on a pan-European scale regarding an excess of inflexible generation for the coming summer period.

On the beneath maps it can be noted that FYR of Macedonia needs to export all weeks of the year in daytime and night time downward calculations. The reason is the small size of the system and its important part of inflexible thermal generation, what results in needed moderate export in downward regulation.

Figure 10: Overview of the export needs for the daytime scenario

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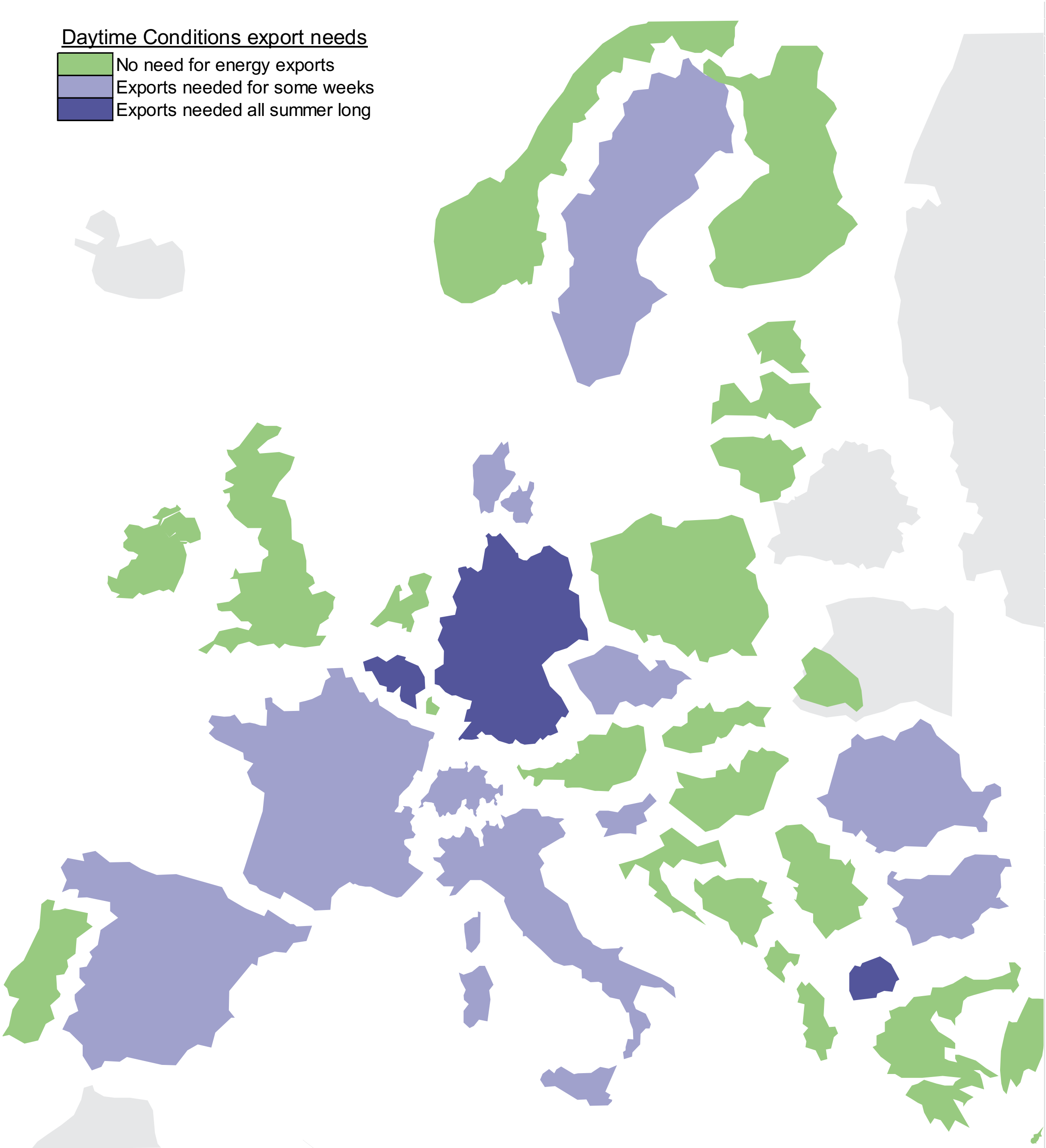
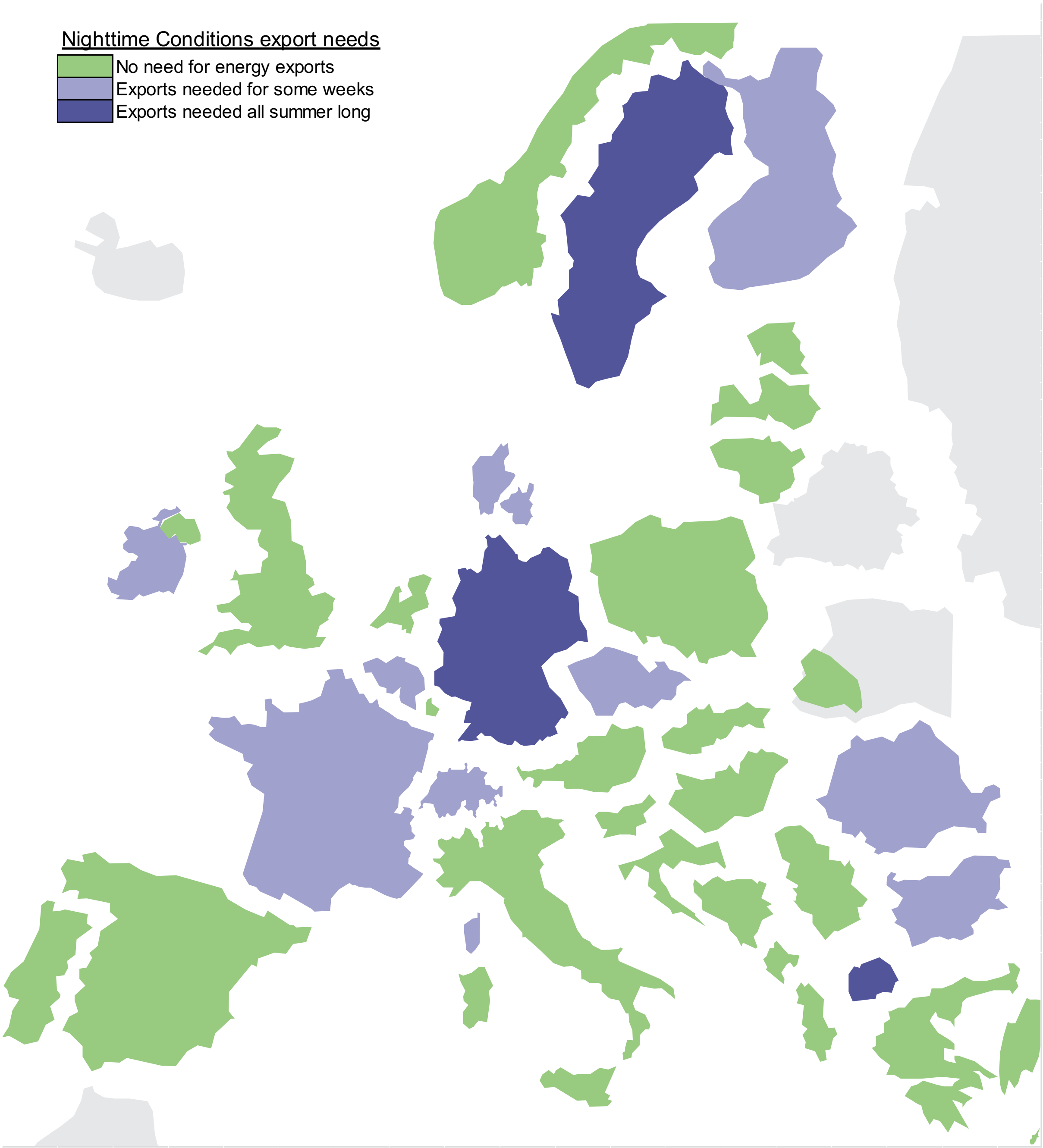

Daytime Conditions export needs
No need for energy exports
Exports needed for some weeks
Exports needed all summer long

Figure 11: Overview of the export needs for the night-time scenario



5. Winter Review 2015/16

The Winter Review 2015/16 report is based on qualitative information submitted in March 2016 through a questionnaire in order to present the most important events that occurred during the winter 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 winter period as well as identified the causes and the remedial actions taken.

5.1. General comments on past winter climate

The winter 2015/2016 was moderate with average monthly temperatures near or higher (up to 4°C in Britain for example) than the average values - as a result, demand was around or lower than the seasonal average in most of European countries, with just a few exceptions such as Finland and Norway where exceptionally cold temperatures and new records of peak load were reached in January. Some countries also experienced dry weather conditions through the winter - where less rainfall caused lower outputs from their hydro power plants.

5.2. Specific events and unexpected situations during past winter

There are only few isolated events regarding transmission network could be mentioned:

- High wind infeed in Germany caused significant limitations on the DK1-DE border.
- A Notice of Insufficient Margin (NISM) was issued in Great Britain on the 4th November 2015 and 40MWs of DSBR (Demand Side Balancing Reserve) was used to meet demand.
- Due to the very high electricity deficit in Latvia and Lithuania the electrical flows were from North to South and the congestions on the border EE-LV in Baltic States have been occurred.
- The Moyle Interconnector between Northern Ireland and Scotland, on a prolonged outage since 2012 limiting it to half its capacity, has been restored to full capacity.
- In January in one week the gas shortage affected some Natural Gas Power plants in Turkey.

5.3. System adequacy conditions in Europe

The system adequacy was comfortably managed during past winter – mainly generation was sufficient to meet demand in Europe and there was no load reduction or major disconnections during winter 2015/2016.

Due to the return of 2 nuclear units (1GW each) during the winter 2015-2016, the adequacy risks for **Belgium** assessed in the Winter Outlook 2015/16 were notably reduced.

In **Switzerland**, during the last months of 2015, a tense situation was experienced:

- Outage of nuclear power plants Beznau 1 and 2 (720MW);
- Rivers with considerably less water compared to the long-term average (run-of-river production), as a result of the dry summer and autumn;
- Water reservoirs filled below average (~1.2TWh below the median of the last 18 years).

However, during the first months of 2016, the situation became increasingly less critical thanks various factors and measures:

- Joint problem-solving by the energy industry: Since December 2015, a working group from the Swiss energy industry (power plant operators, distribution system operators and traders) has been developing solutions to ease the situation. Swissgrid has also introduced and implemented additional technical and market-oriented measures in close coordination with European transmission system operators.
- Mild temperatures: the unusually mild temperatures this winter have resulted in reductions in grid load and in overall consumption, which has had a positive effect on the energy supply and grid situation. Thanks to frequent rainfall since mid-January, electricity production from run-of-river production has also been higher than normal for this time of the year.
- Restarting of Beznau 2: Since the restarting of Block 2 of the Beznau nuclear power plant on 23 December 2015, a proportion (360MW) of the unavailable base load is once again supplied into the 220-kV grid.

6. Appendices

Appendix 1: Individual country comments on the Summer Outlook 2016

Albania

Most of the maintenance works in generation – transmission system will be performed during summer period from April till October. The most critical period remains during months of July and August, depending from the temperatures, and due to that, the maintenance schedule of units and transmission elements in that period is set to minimum. This period is also characterized by low hydro levels. Albania does not foresee any unexpected event that may affect the adequacy during this period.

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

The most critical period remains during months of July and August, depending from the temperatures, and due to that, the maintenance schedule of units and transmission elements in that period is set to minimum. Thermal power plant Vlora will be used only in cases of very dry summer according to KESH GEN[20], hence the adequacy will be maintained with firm contracts of imports from OSHEE (DSO) around 300MW. In general the interconnections are sufficient for fulfilling the need of electricity imports, and also for exports if it will be the case, and they are used as well for transits, mainly towards Greece. The maintenance of the interconnectors is arranged to be in the period of April – May and September – October, when the demand is relatively lower, also in the neighbouring TSOs, thus the adequacy will be maintained.

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

Albania has not yet inflexible generation, thus it is not expected to have any problem with demand minimum periods. The export capacity of our interconnectors is expected to be around 700 MW when the new 400kV Line Tirana2-KosovaB will be in operation.

[20] Regarding the wholesale activity within the Albanian Market Model, KESH Gen is given a mission to supply energy for captive customers and operate in a way to financially mitigate the hydrological risk inherent in the Albanian supply portfolio.

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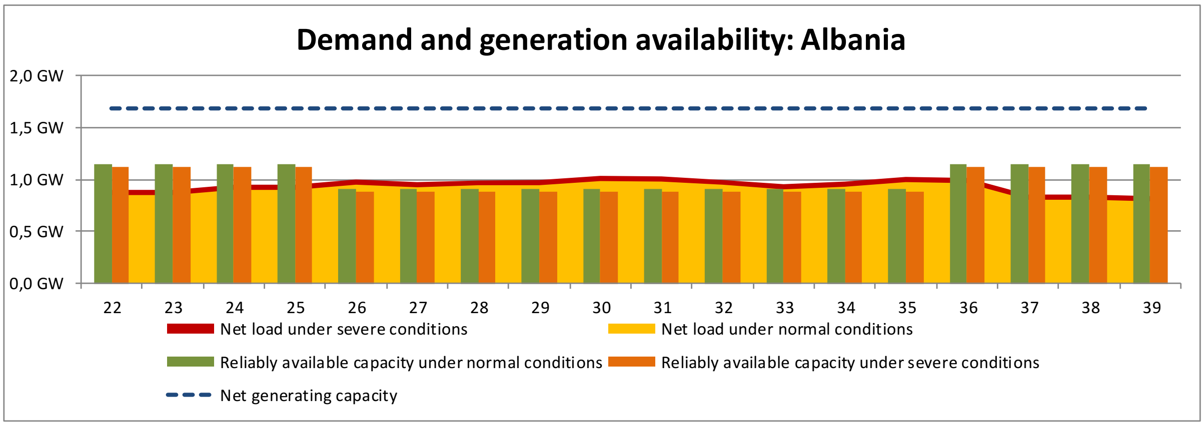
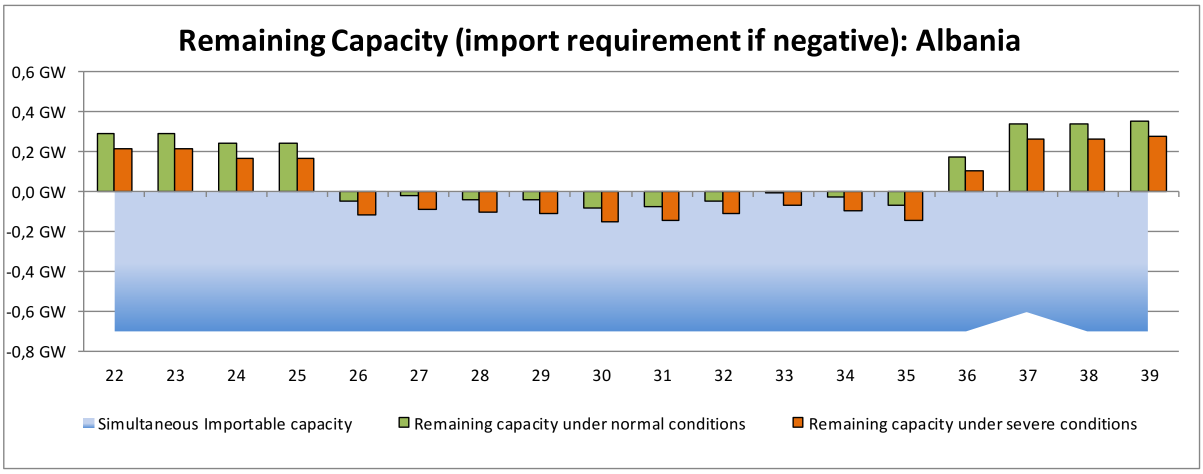
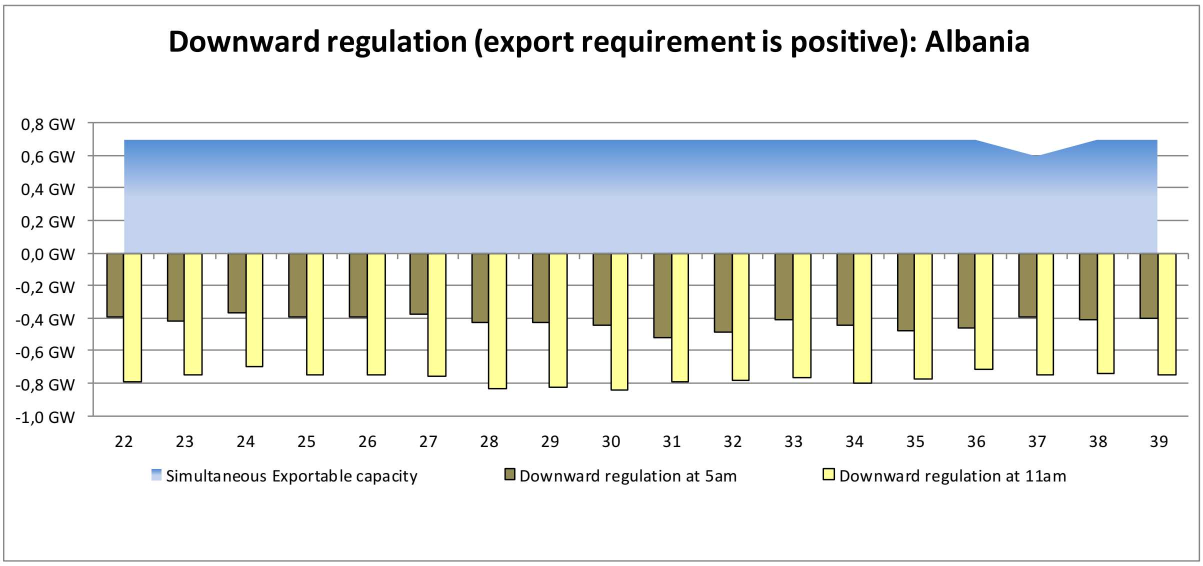

Demand and generation availability: Albania
2,0 GW
1,5 GW
1,0 GW
0,5 GW
0,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity


Remaining Capacity (import requirement if negative): Albania
0,6 GW
0,4 GW
0,2 GW
0,0 GW
-0,2 GW
-0,4 GW
-0,6 GW
-0,8 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Downward regulation (export requirement is 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
-1,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Austria

According to the deterministic capacity adequacy methodology no problems have been detected for Austria for the upcoming summer. The remaining capacity will be even higher than the years before due to following reasons:

The installed power plant capacity is going to increase in summer 2016 (e. g. the new pumped storage power plant Reisseck 2). But also a lot of renewables are going to go into operation. Here the methodology of the availability of renewable energy sources has been changed and so will be considered higher than the years before (cf. Pan-European Climate Database). In the end there are capacities of thermal power plants contracted for congestion management measures this summer (Austrian grid reserve).

Due to the high number of installed capacity of pumped storage power plants the deterministic assessment covers potential capacity problems e. g. of low water levels of impounding reservoirs as a result of long droughts.

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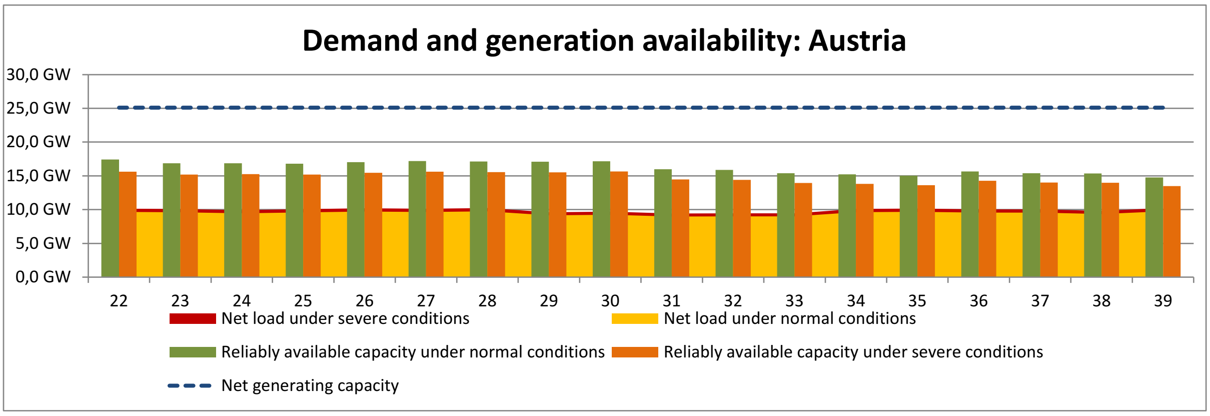
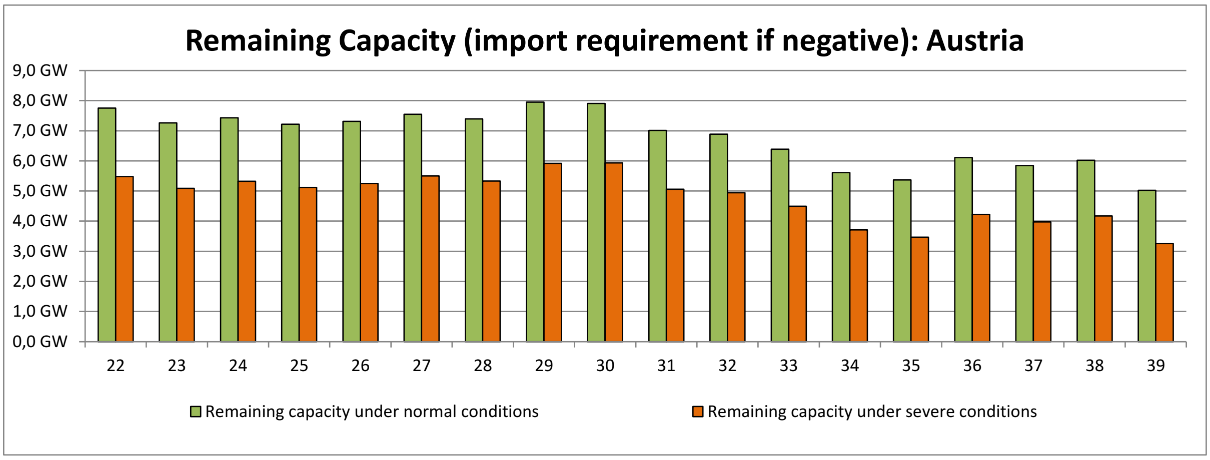
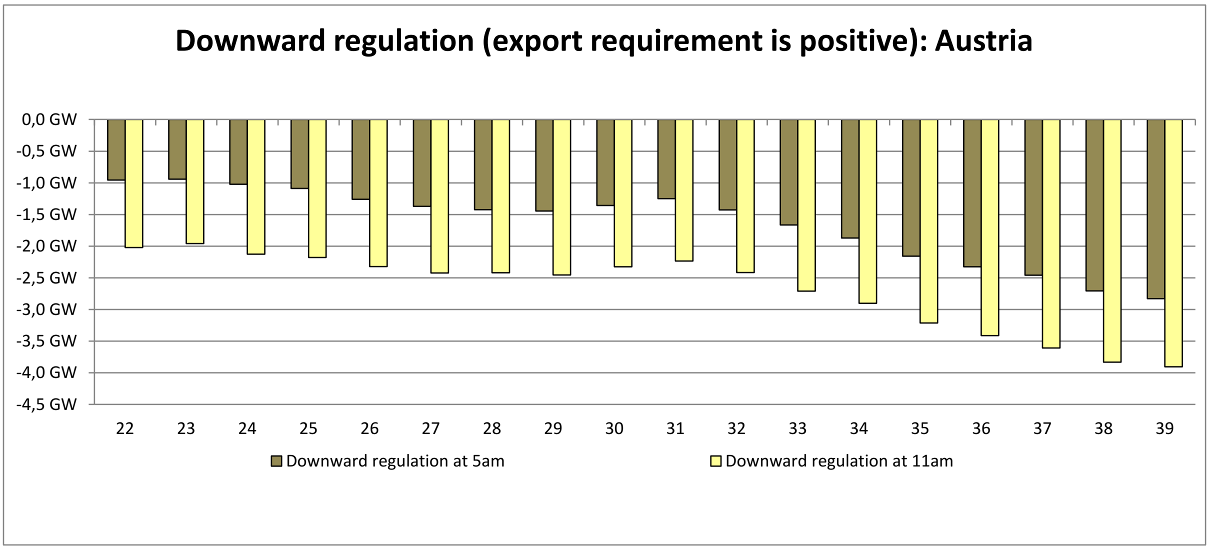

Demand and generation availability: Austria
30,0 GW
25,0 GW
20,0 GW
15,0 GW
10,0 GW
5,0 GW
0,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity


Remaining Capacity (import requirement if negative): Austria
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
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Downward regulation (export requirement is 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
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Downward regulation at 5am
Downward regulation at 11am

Belgium

Due to the return of 2 nuclear units (1GW each) during the winter 2015-2016, the adequacy risks for Belgium are reduced. This makes that in normal conditions Belgium has a small positive remaining capacity. In severe conditions the remaining capacity becomes negative, with sufficient import capacity.

The import capacity is increased compared to the analysis of 2015 due to an additional PST on the north border.

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

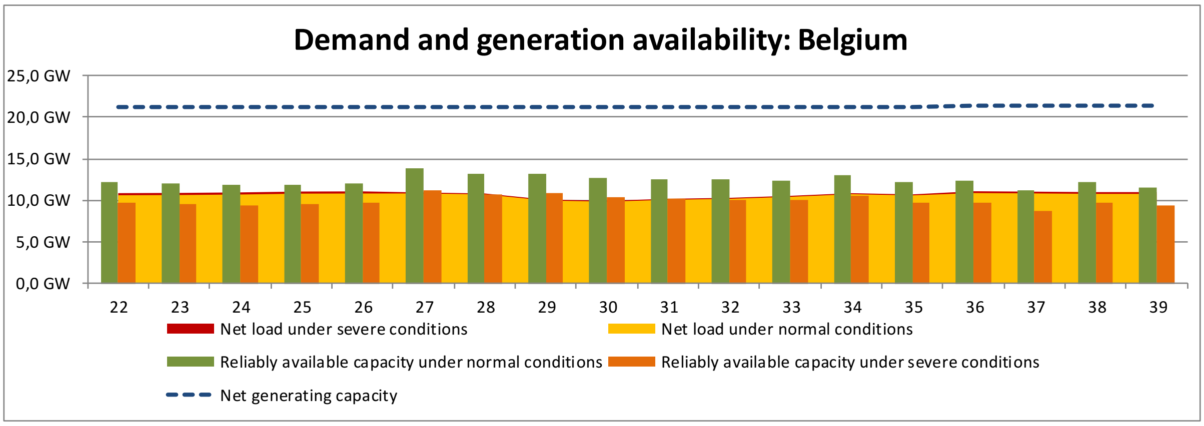
In the winter period Belgium can count on additional strategic reserve (for winter 2015-2016 ~1,5GW) in case of adequacy issues. However, in summer there is no need for this additional reserve capacity since the interconnection capacity is sufficient in Belgium, even in severe conditions.

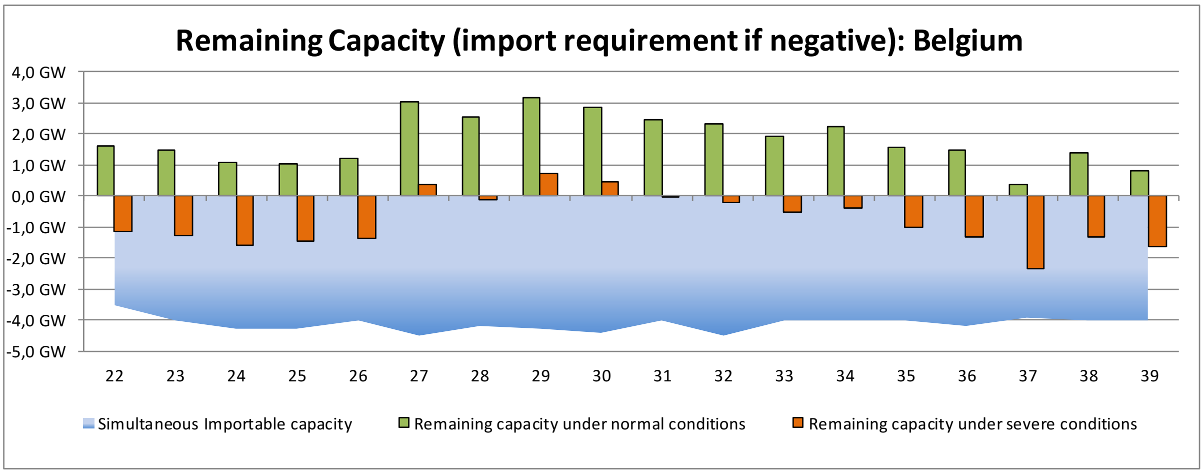
Most critical periods for downward regulating capacity, countermeasures adopted and expected role of interconnectors in managing an excess of inflexible generation

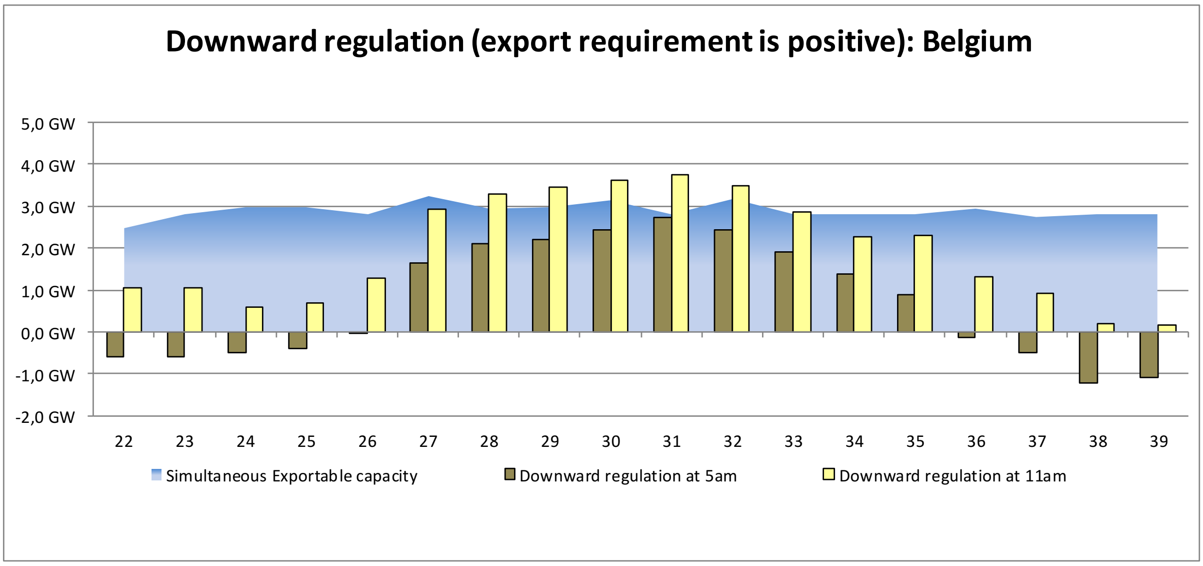
Due to the return of 2 nuclear units (1GW each), the amount of inflexible generation increased which can lead to periods of excess capacity in summer. The main drivers for an excess of inflexible generation are reduced load, increased wind and solar production and high availability of nuclear units.

In case of normal wind and solar conditions (P50) the excess is mainly limited to weekends and the holiday period. In these cases the export capacity should be sufficient.

In case of high wind and solar conditions the excess is increasing. In most cases the export capacity should be sufficient, however in some specific cases additional measures may be needed (for example modulation on nuclear units, optimisation of export capacity...). These additional measures (before curtailing the output of renewable energy sources) are not included in the data collection.







Bosnia and Herzegovina

Bosnia and Herzegovina does not expect any particular problem, regarding power system adequacy for the summer 2016. The maintenance of thermal power plant Ugljevik (NGC of 279 MW) is expected in June, July and August. But, new thermal power plant Stanari (NGC of 262,5 MW) would start operation on May 2016, so that the Net Generating Capacity for summer period would remain on the approximately same level. In Bosnia and Herzegovina there are not yet intermittent energy sources like wind or solar, to be taken into account in the assessment.

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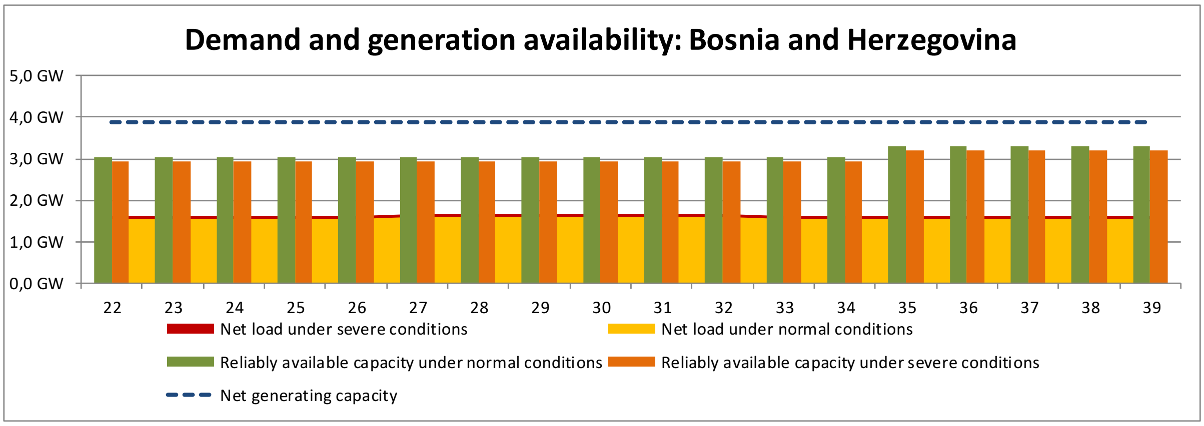

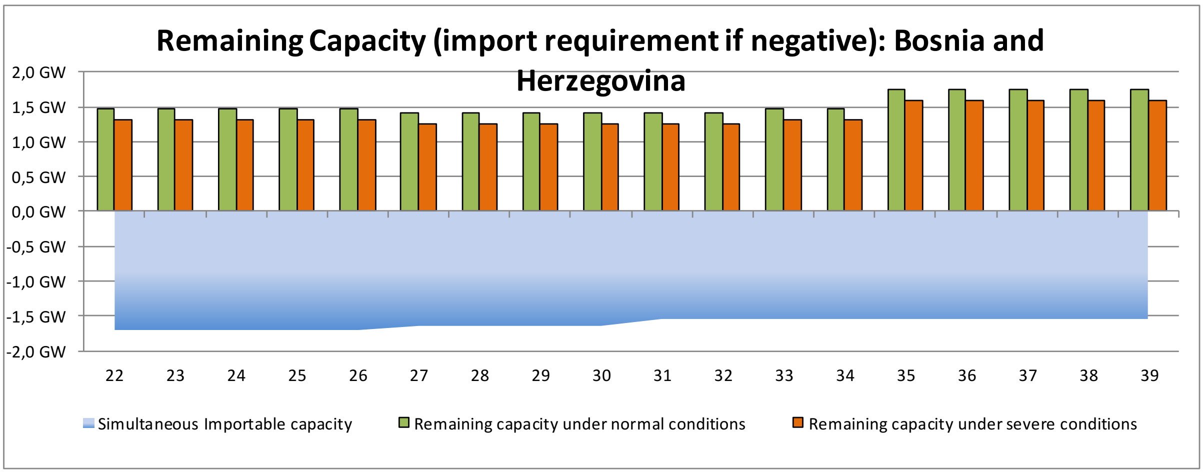

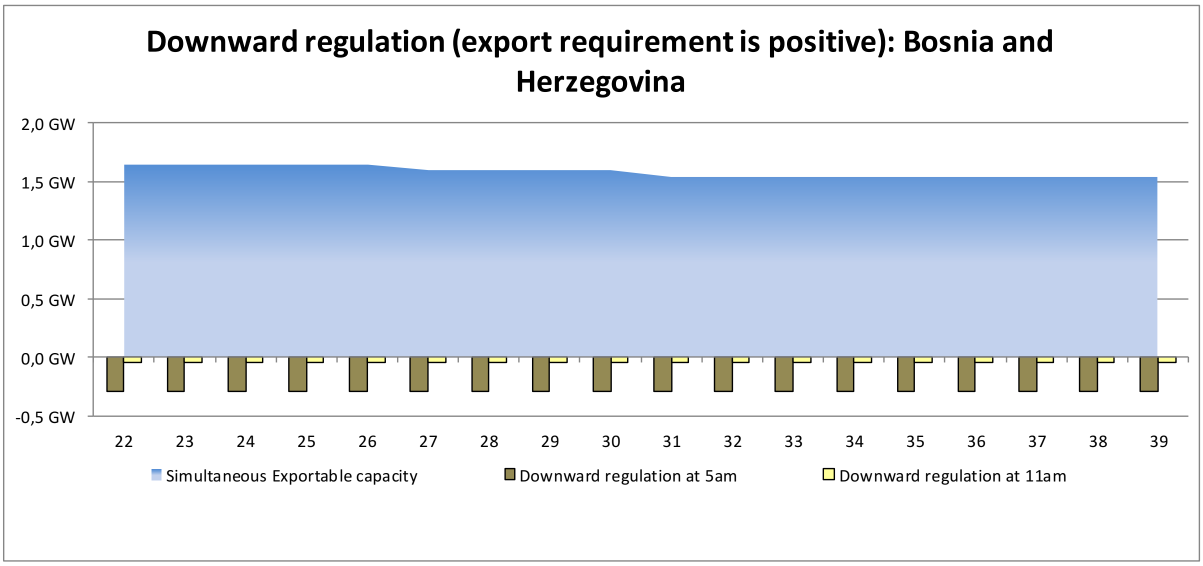

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Bulgaria

The high level of penetration of RES (mostly PV) combined with the probability of low demand and low exports could cause balancing problems during some clear sky days, i.e. excessive generation which might have to be curtailed.

The water levels in the big reservoirs are expected to be a little below target levels and therefore some limitations to hydro power plants operation is possible.

The approved maintenance program does not suggest any problems for the forth-coming summer period.

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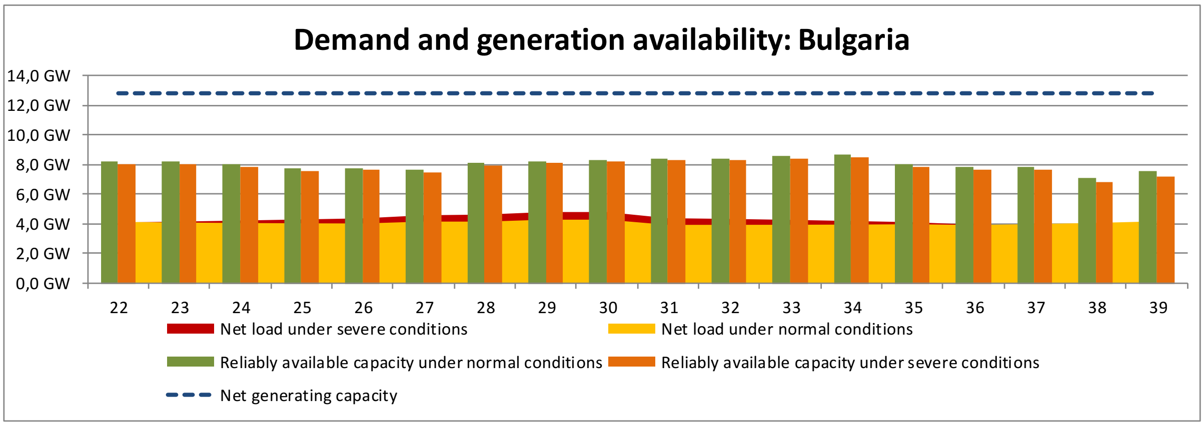
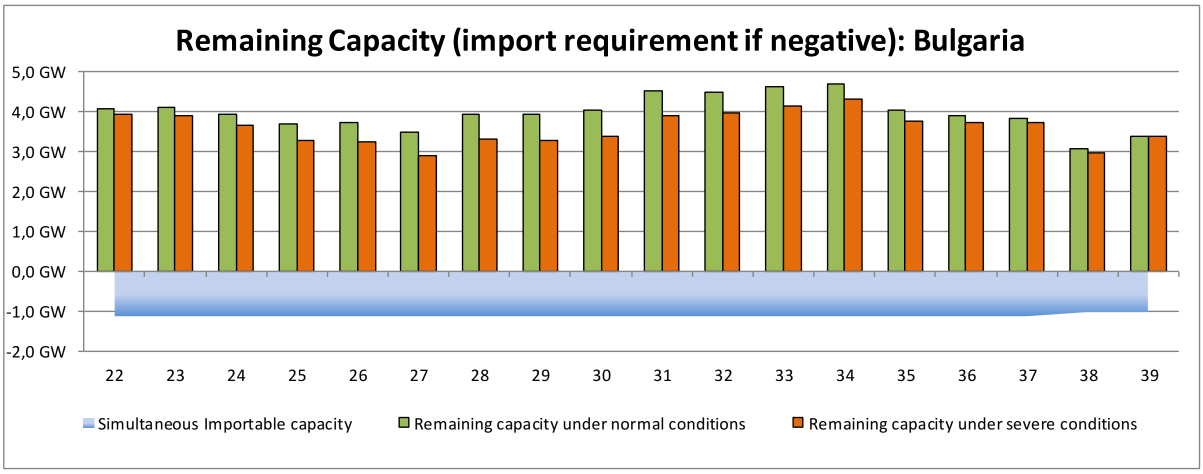
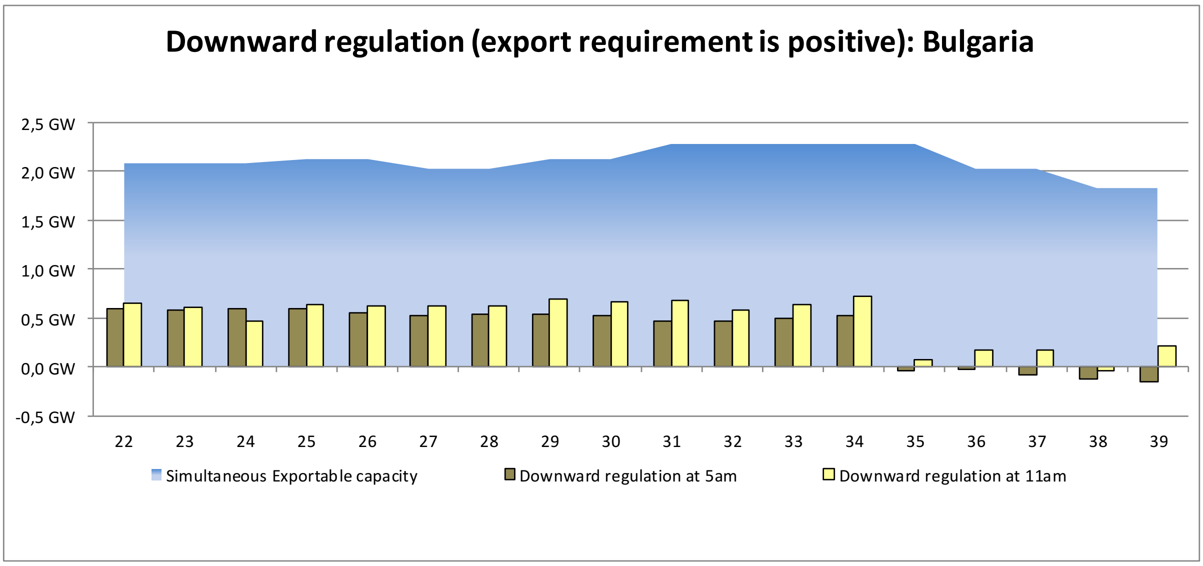

Demand and generation availability: Bulgaria
14,0 GW
12,0 GW
10,0 GW
8,0 GW
6,0 GW
4,0 GW
2,0 GW
0,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity 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
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Downward regulation (export requirement is positive): Bulgaria
2,5 GW
2,0 GW
1,5 GW
1,0 GW
0,5 GW
0,0 GW
-0,5 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Croatia

At beginning of March 2016 in Croatia approximately a half of hydro storage capacities was filled. As usual, a high level of maintenance is expected to be performed during summer. It is expected that domestically generation capacities will be not satisfying to meet demand in some periods and the import will be needed. On the other side, it is not expected any problem with the transmission capacity of tie-lines.

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

Extremely high air temperatures cause most critical periods in Croatian power system. According to the experiences of summer 2015 hot weather may have an impact on growth of consumption especially in July when population is still not on holiday. The amount of electricity import which is needed depends on situation in hydro storages and the estimation of electricity producers if the production in thermal power plants (particularly those that use gas as primary source of energy) is economical.

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

Periods with strong wind and low consumption are the most critical periods for downward regulating capacity.

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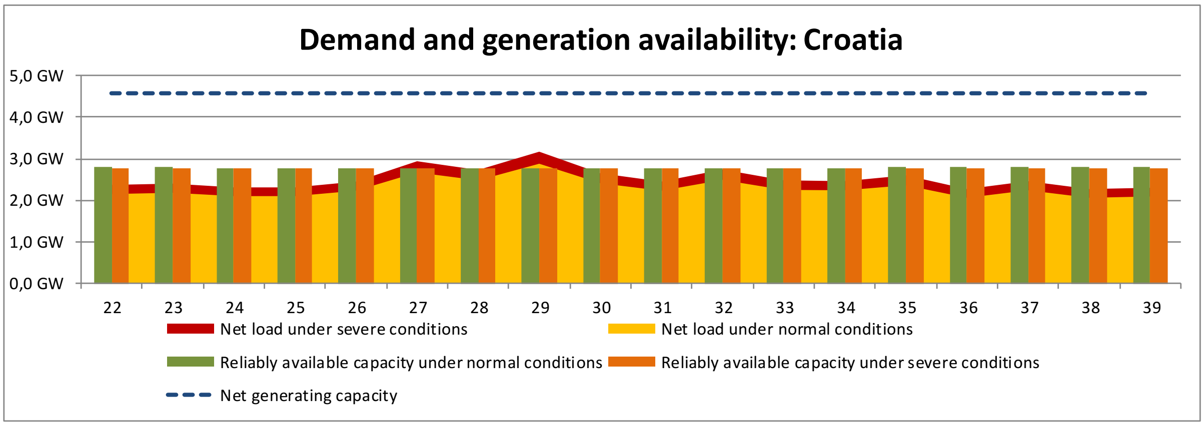
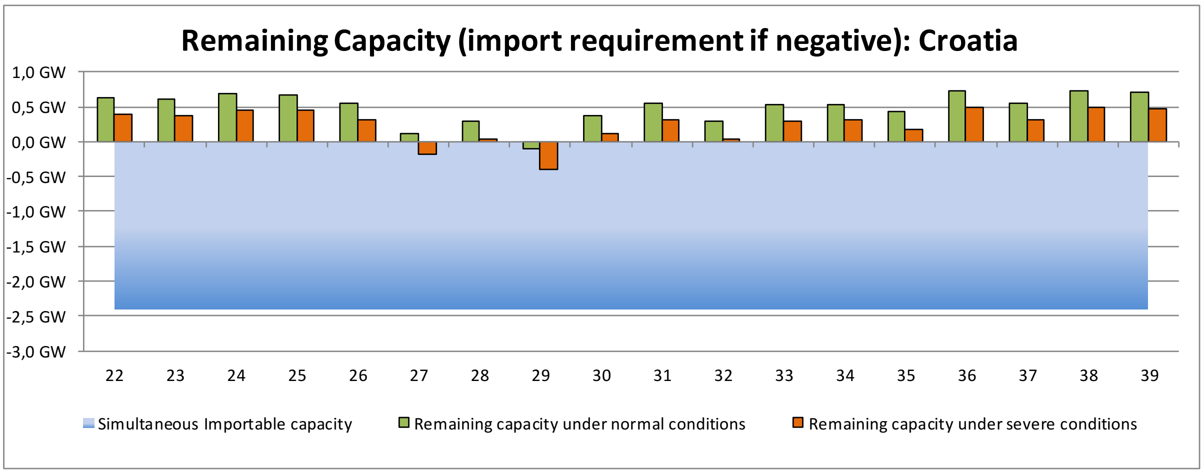
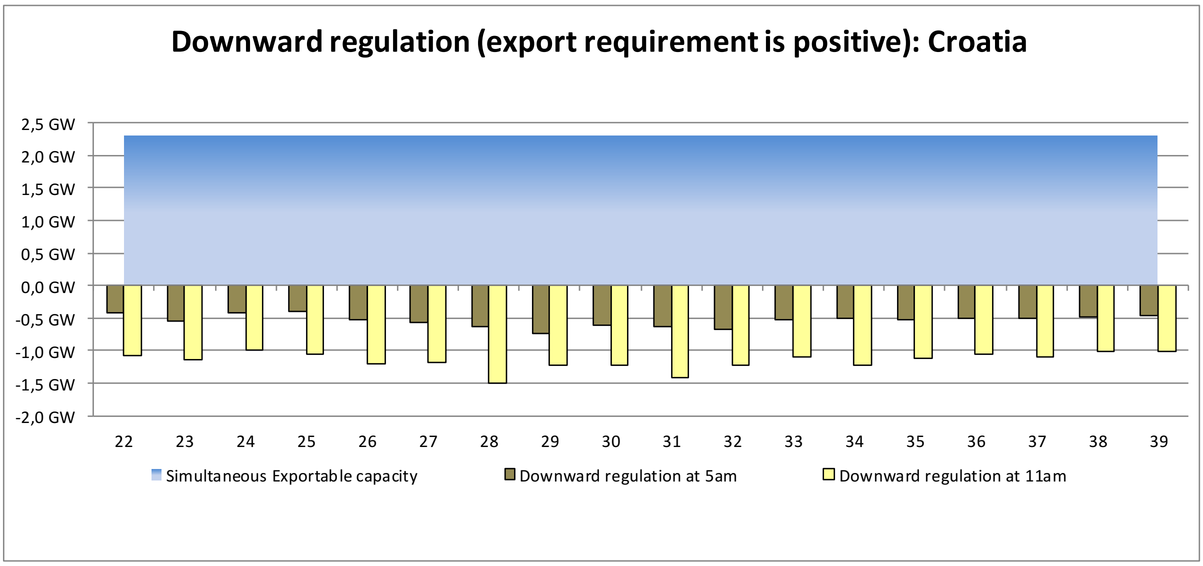
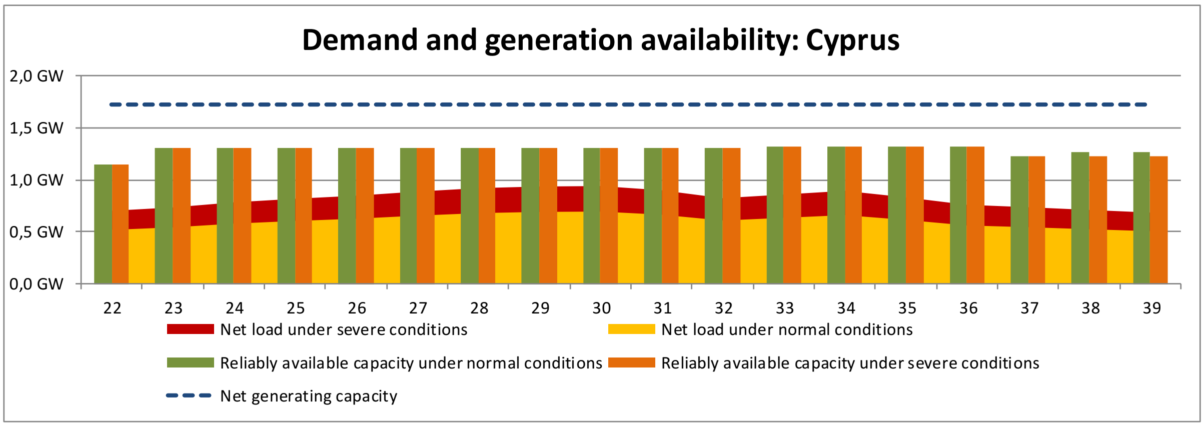

Demand and generation availability: Croatia
5,0 GW
4,0 GW
3,0 GW
2,0 GW
1,0 GW
0,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity

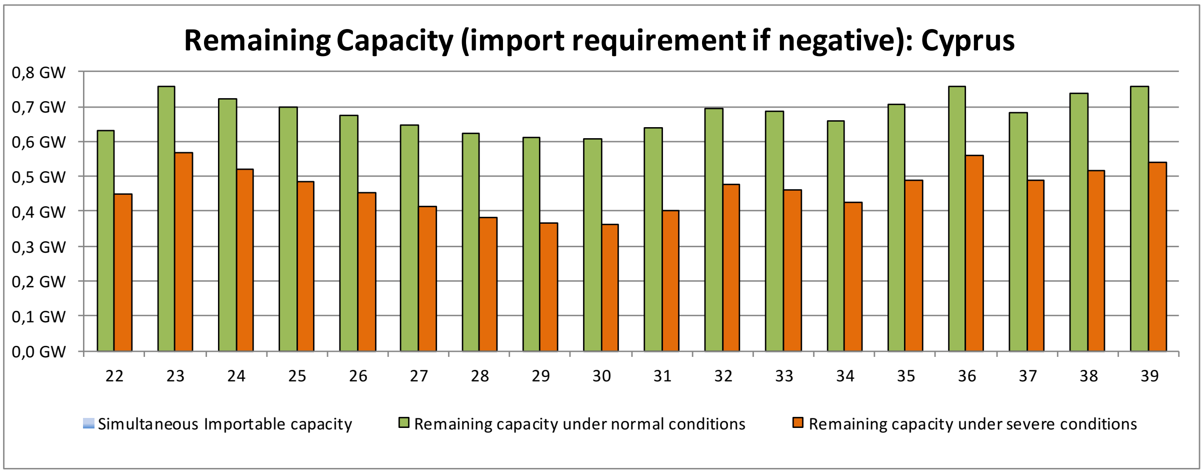

Remaining Capacity (import requirement if negative): Croatia
1,0 GW
0,5 GW
0,0 GW
-0,5 GW
-1,0 GW
-1,5 GW
-2,0 GW
-2,5 GW
-3,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions

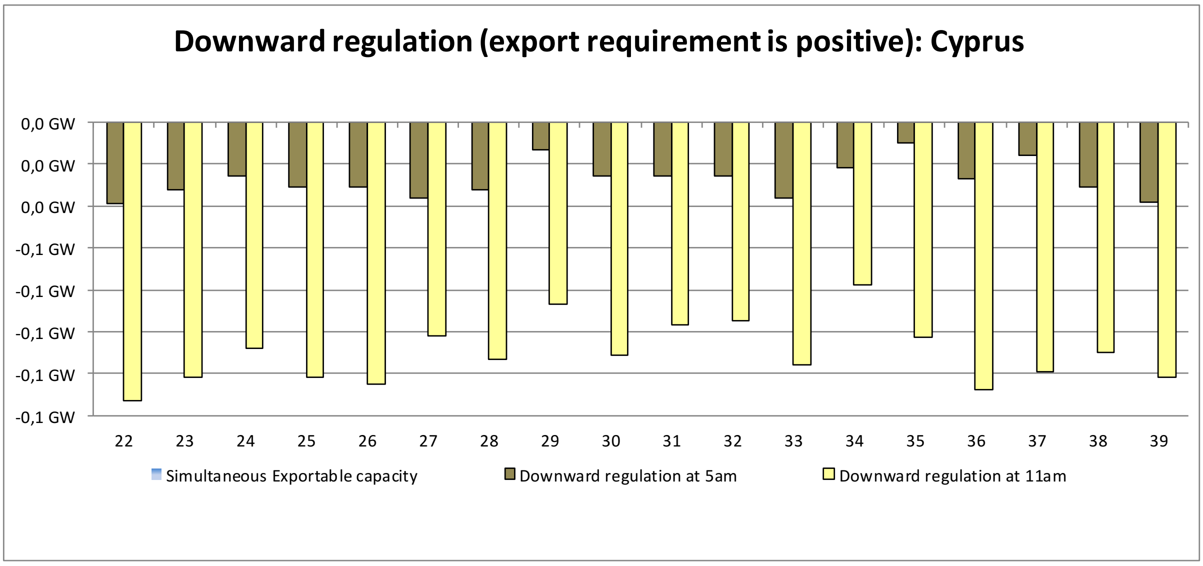

Downward regulation (export requirement is positive): Croatia
2,5 GW
2,0 GW
1,5 GW
1,0 GW
0,5 GW
0,0 GW
-0,5 GW
-1,0 GW
-1,5 GW
-2,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Cyprus

Cyprus does not expect adequacy issue for the coming summer.







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Czech Republic

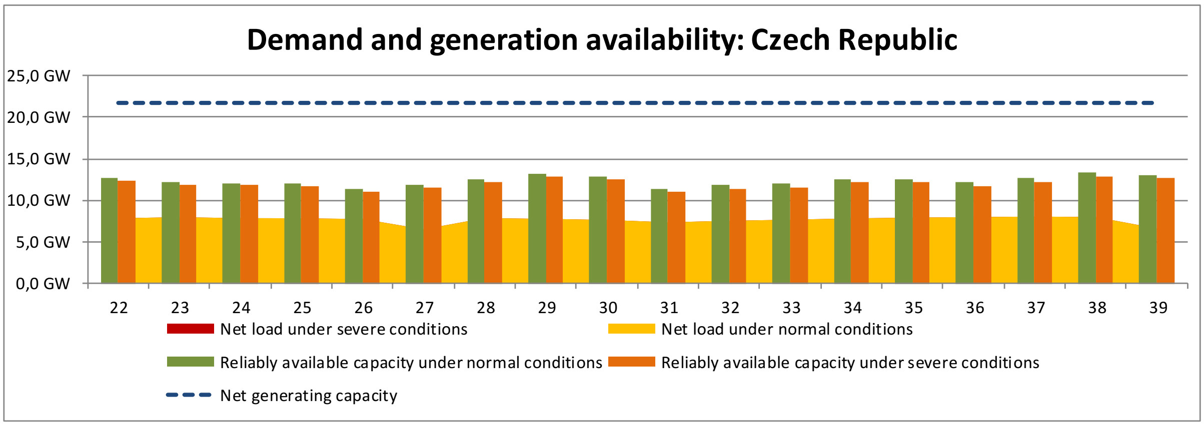
During summer period Czech Republic doesn't expect any event that may significantly affect the adequacy. It was assumed that the load will be in the range of 6.5 GW to 8.03 GW during the summer period. The highest value of the maintenance which corresponds with typical values for this period is foreseen on week 26. The information about gas storage is not available as the providers are not obliged to inform about their level of the fuel storage.

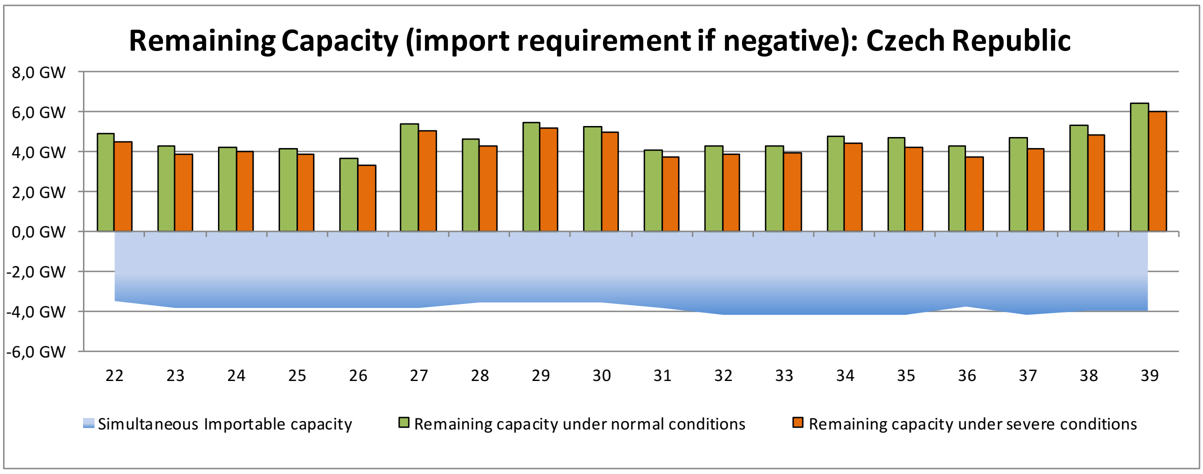
Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

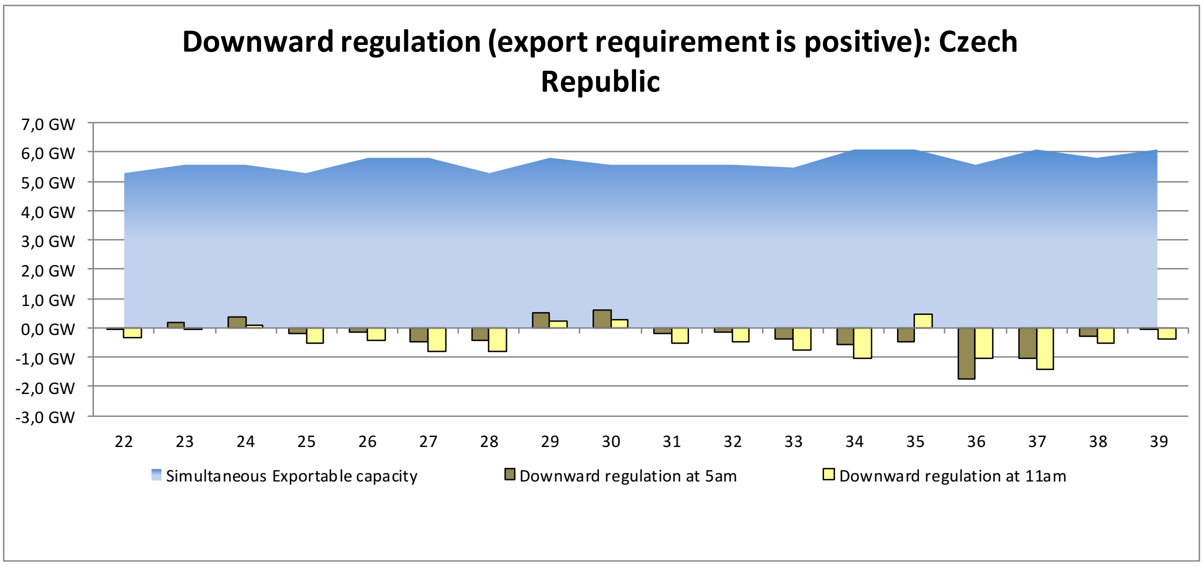
Due to planned commissioning of PST in Mikułowa (Poland) on the double line 400kV in May 2016 and consequent outage of other double line 220kV on the German-Polish profile at the beginning of June, CEPS expects a significant increasing of transiting flow from 50Hertz and necessity of a massive re-dispatch (bilateral or multilateral) to keep security in the whole region.

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

Regarding quite high level of must run the yearly load minimum could be considered as the most critical period in the summer outlook. Load minimum is expected between weeks 27 and 39. Sufficient amount of ancillary services for downward regulation has been procured. However export is necessary condition for securing enough downward regulation at the spinning units.


Demand and generation availability: Czech Republic
25,0 GW
20,0 GW
15,0 GW
10,0 GW
5,0 GW
0,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
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
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Downward regulation (export requirement is 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
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Denmark

Over the coming summer there will be several prolonged restrictions in the Danish grid, particularly from August and onwards are inflicted.

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

In DK-East (DK2), substation Ishøj will be under refurbishment for 3-4 weeks which can lead to market restrictions. Additionally, the 400kV substation Sôderåsen will be under refurbishment for 4 weeks which will lead to restrictions on the DK-2-SE4 border. During these 4 weeks the power balance in DK2 may be strained.

In DK-West (DK1) the overhead line from Ferslev to Tjele will have thread changed over a period of 3 months which can lead to constrained capacity on the DK1-SE3 connection. Additionally there are other minor refurbishments which can lead to minor reductions on the Danish interconnectors.

The power balance is expected to be good over the summer as a whole, but during the weeks with work restricting the DK2-SE4 border it will most likely be strained. It is not expected that the power plant availability will lead to problems.

The work on the cabling project “Vejle Ådal” in continuing and is not expected to lead to problems. The takeover of the 132/150kV grid is finished, however there is still work to be done in order to incorporate it all into the SCADA system from the old one.

Over the summer, massive amounts of countertrading from TenneT DE is expected, particularly at times with high wind and while doing refurbishments in the grid.

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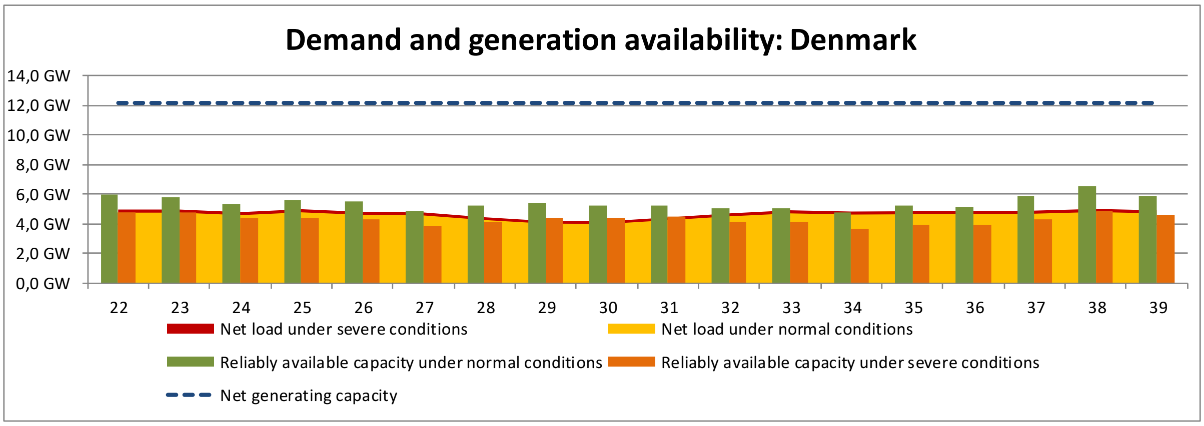
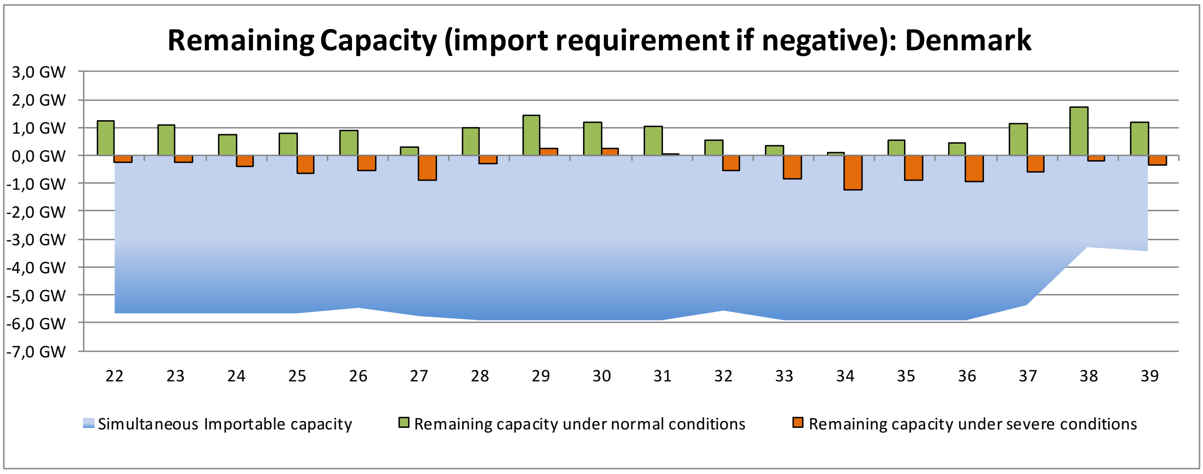
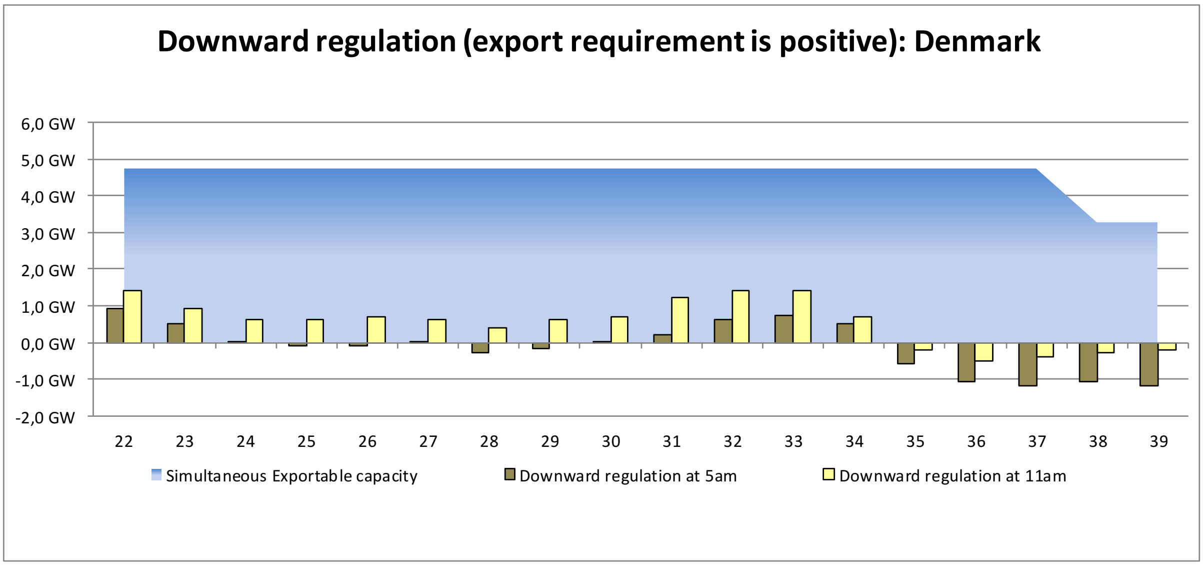

Demand and generation availability: Denmark
14,0 GW
12,0 GW
10,0 GW
8,0 GW
6,0 GW
4,0 GW
2,0 GW
0,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity 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
-6,0 GW
-7,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Downward regulation (export requirement is positive): Denmark
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
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Estonia

The preliminary number of planned maintenance works is quite same as it has been in past years.

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

The lowest import/export capacity is at the beginning of June, when the annual maintenance of EstLink 1 is planned. The most critical period might be during week 33 and 34 when the transfer capacity to Latvia is limited to 500 MW. The usual case is that the energy flow is to Lithuanian and Latvian power system, thus there might occur some stressed period for interconnection between Estonia and Latvia. However new DC connections to Lithuania (Nordbalt and Litpol link) should decrease the power flows to Lithuania via Latvia and Estonia. Generally in summer maintenances which decrease significantly capacities in Estonia/Russia-Latvia interconnection are limited to avoid congestion. Nevertheless there is enough of production through the summer to cover peak load.

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

The part of inflexible generation in the system is not significant and no problems are expected for managing the excess of inflexible generation.

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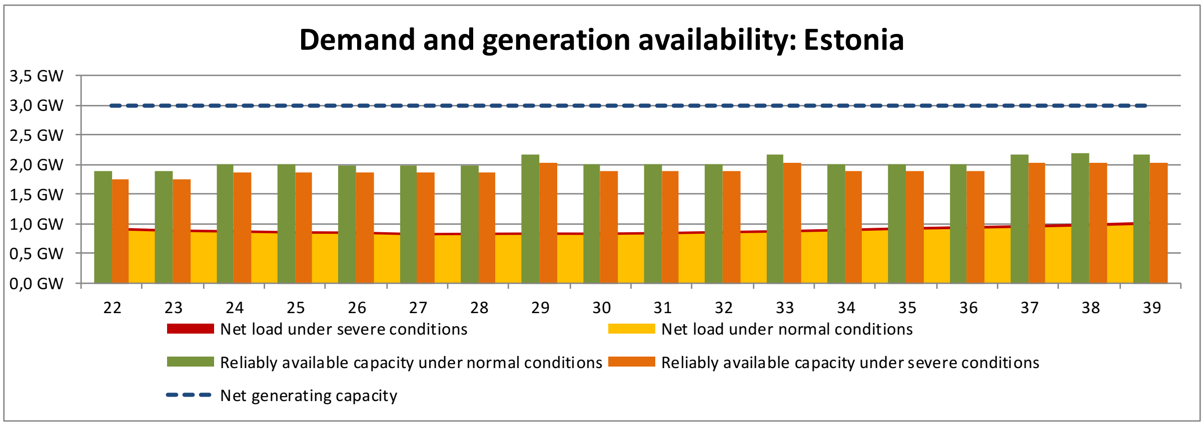
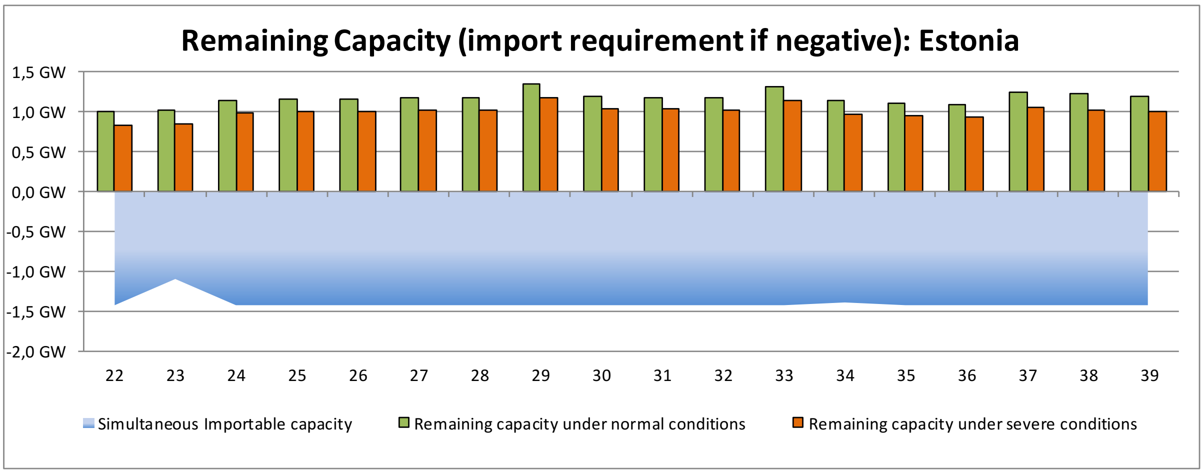
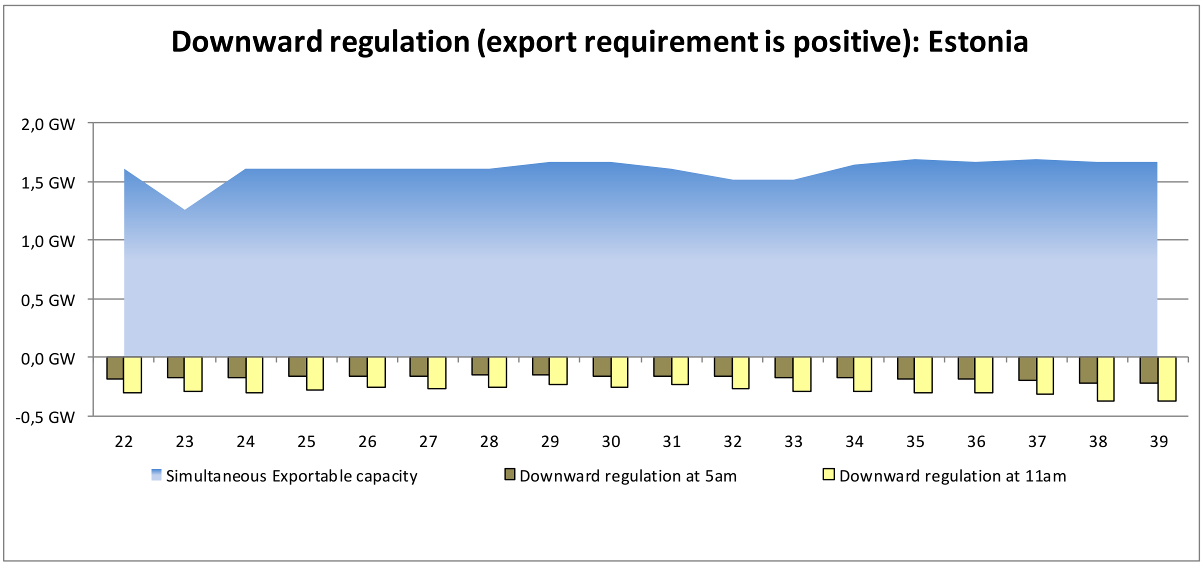

Demand and generation availability: Estonia
3,5 GW
3,0 GW
2,5 GW
2,0 GW
1,5 GW
1,0 GW
0,5 GW
0,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under 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
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Downward regulation (export requirement is positive): Estonia
2,0 GW
1,5 GW
1,0 GW
0,5 GW
0,0 GW
-0,5 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Finland

Summer peak load in Finland is 60 to 70 % of the corresponding winter peak value and therefore summer is not as critical from adequacy's perspective as winter. However, maintenances and overhauls of heat power units limit available generation capacity in summer time. In addition, there are some maintenances in interconnectors.

Nevertheless, demand can be met with available generation capacity and there is also high level of import capacity available.

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

Week 26 to 31 is busiest maintenance period and therefore available generation capacity is low. At that time demand is usually also low and there is import capacity available, so no adequacy problems are expected.

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

There are no specific export needs due to inflexible generation at minimum demand period.

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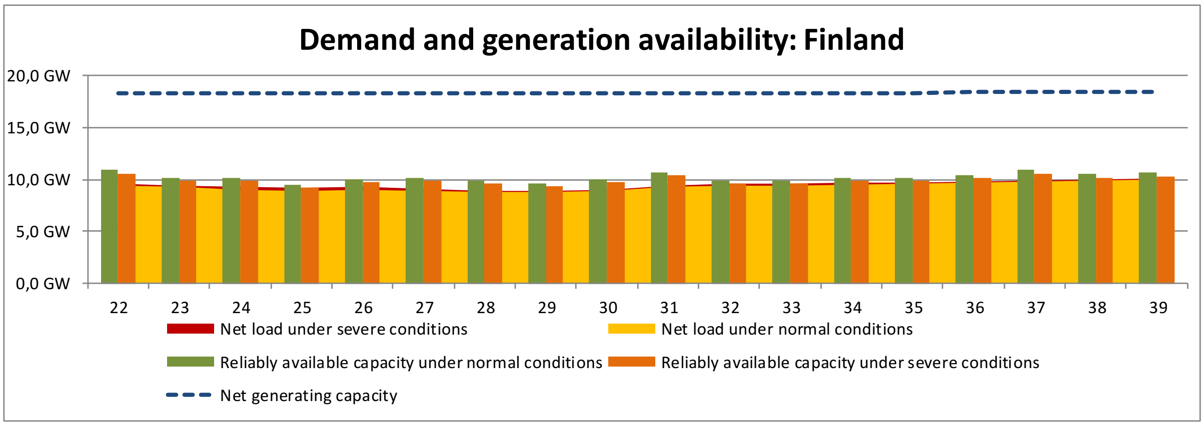
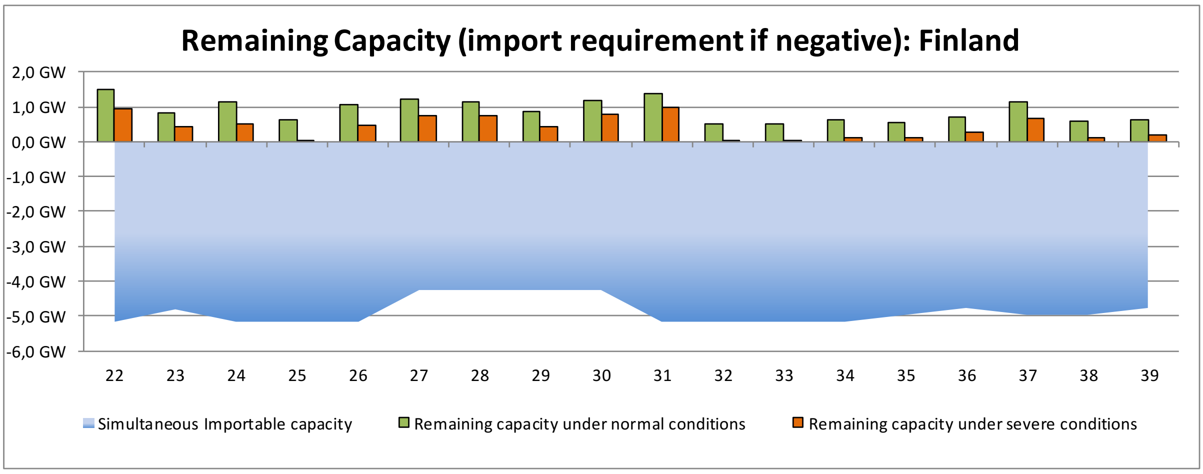
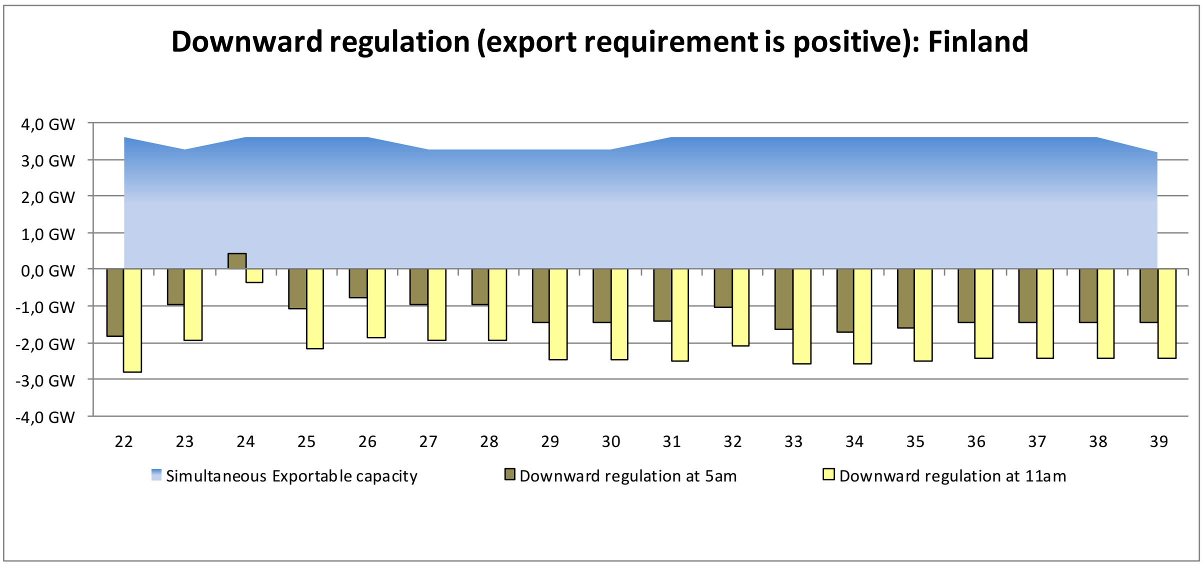

Demand and generation availability: Finland
20,0 GW
15,0 GW
10,0 GW
5,0 GW
0,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity


Remaining Capacity (import requirement if negative): Finland
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
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Downward regulation (export requirement is 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
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

France

The upward margins will remain positive during all summer, even in severe conditions. Unlike the results of market based approach, France is expected to export all summer. This discrepancy is due to the simplified merit order used so far[21].

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

The most critical period for severe conditions is week 30, with a high level of nuclear maintenance, combined with the availability of nuclear plants which are non-usable during a hot wave. Yet upward margins should remain positive all over summer.

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 for downward regulation should happen in the early summer (week 23), due to numerous nuclear power plant that must run close to their maximum power, with around 3 GW of exports needed. In case of an excess of power in the whole area, some of these nuclear plants should be able to completely stop during low consumption periods and week-ends in particular - as every summer.

[21] Merit order approach is described in section 3.4.1

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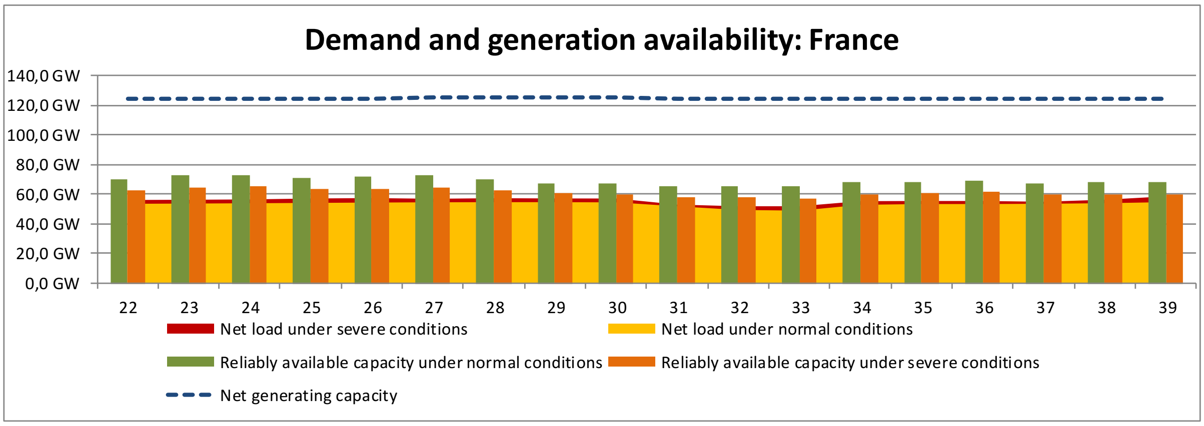
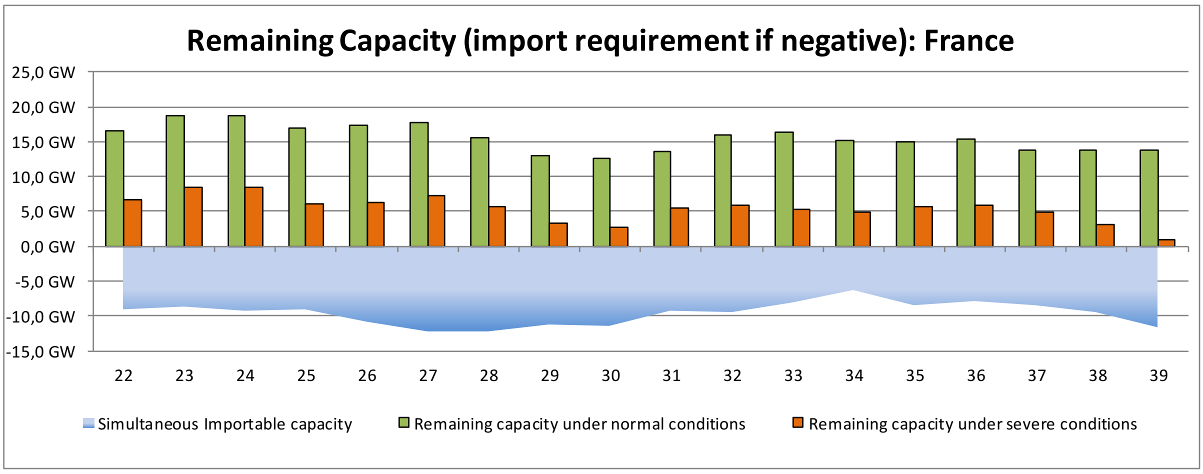
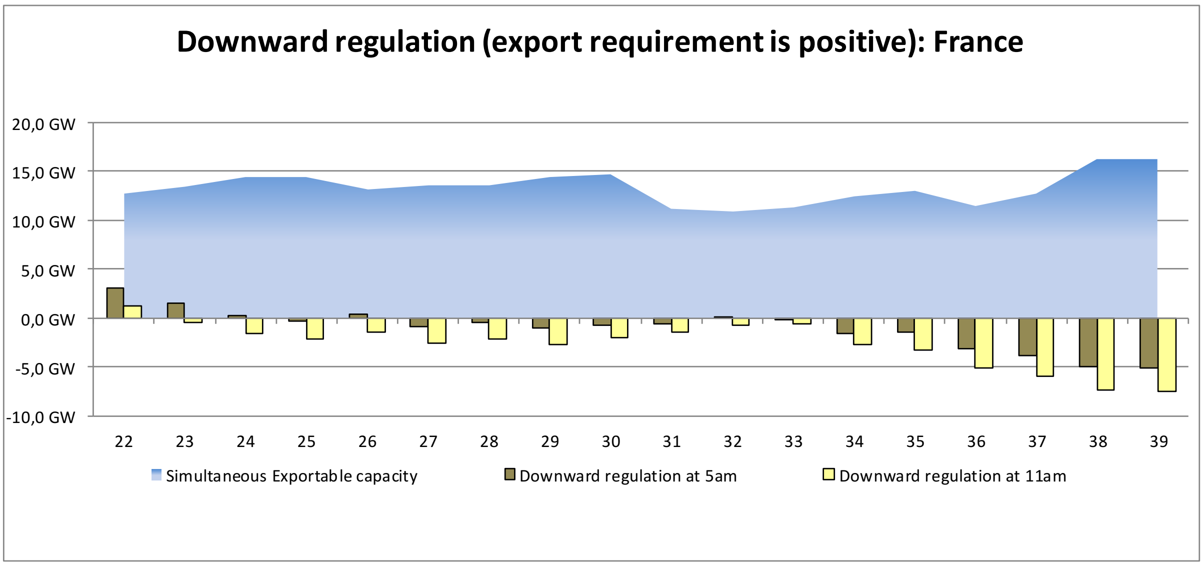

Demand and generation availability: France
140,0 GW
120,0 GW
100,0 GW
80,0 GW
60,0 GW
40,0 GW
20,0 GW
0,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity


Remaining Capacity (import requirement if negative): France
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
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Downward regulation (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
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

FYR of Macedonia

Compared to other years, this year is characterized by higher temperatures and, as a consequence, reduced consumption.

The lack of snow in the winter may result with a deficit of energy produced from hydroelectric facilities.

Interconnections would have a key role in the summer period due to the large transit in north-south direction.

During the calculation for normal and severe conditions is assumed:

The load for normal condition in the relevant week for the relevant hour is calculated as a product of the appropriate load in the last year and % of the average load growth for the respective week taking in to consideration the trend for the last few years.

The load for severe condition it is assumed that will increase by 10% assuming that temperatures will be higher than usual and will require additional cooling, in this conditions the hydro production will be available with 60% of installed capacity. For the analysed period grid fills the criteria of adequacy.

Cross-border transmission capabilities of the Republic of Macedonia is such that they can support all import or export electricity transactions to/out of the Republic of Macedonia, while allowing unobstructed transit of energy across the region.

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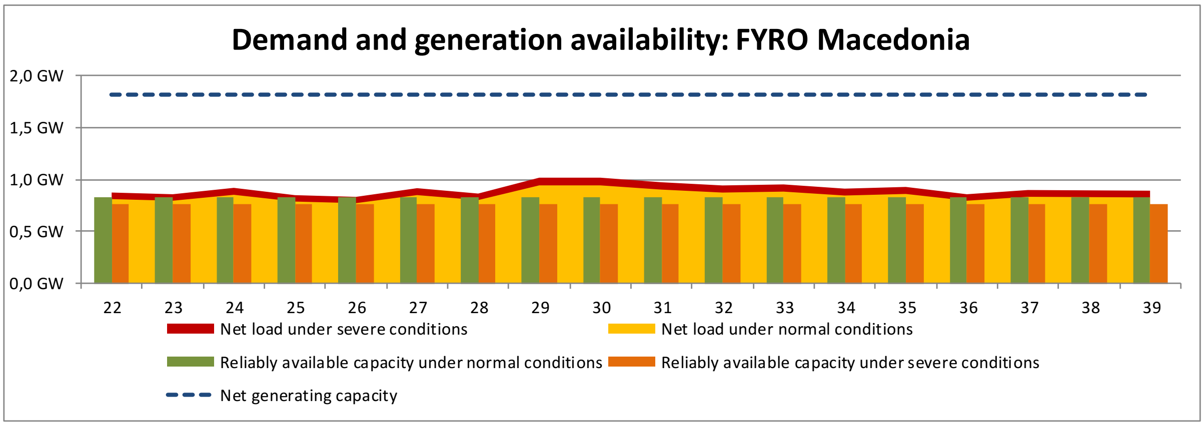
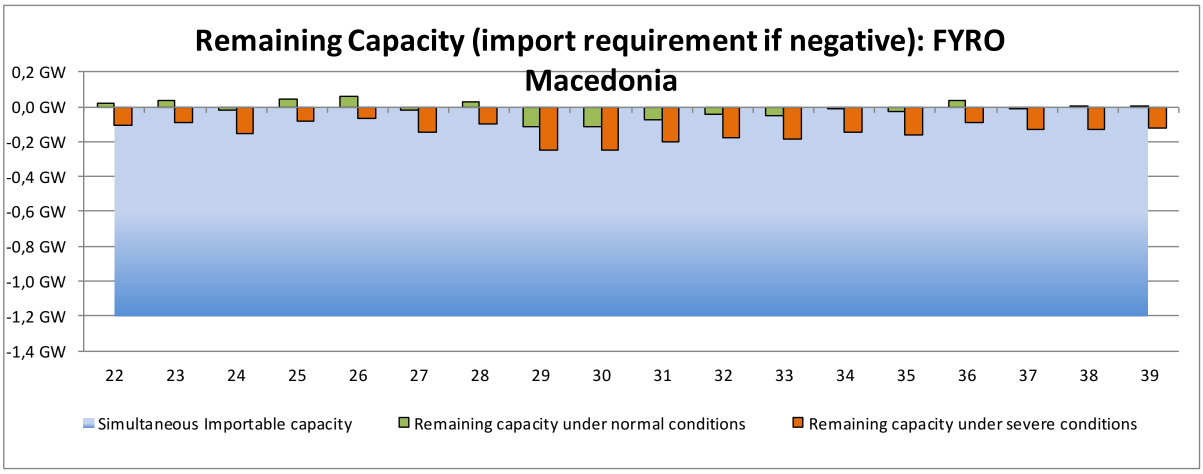
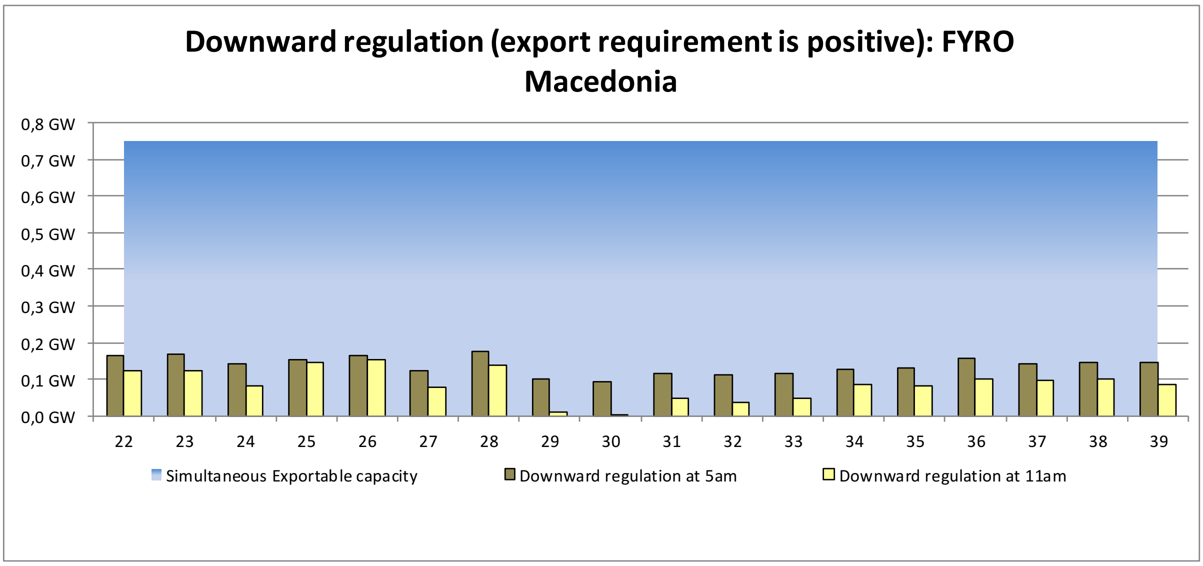

Demand and generation availability: FYRO Macedonia
2,0 GW
1,5 GW
1,0 GW
0,5 GW
0,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity


Remaining Capacity (import requirement if negative): FYRO Macedonia
0,2 GW
0,0 GW
-0,2 GW
-0,4 GW
-0,6 GW
-0,8 GW
-1,0 GW
-1,2 GW
-1,4 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Downward regulation (export requirement is positive): FYRO Macedonia
0,8 GW
0,7 GW
0,6 GW
0,5 GW
0,4 GW
0,3 GW
0,2 GW
0,1 GW
0,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Germany

The German TSOs do not expect significant problems with the generation-load balance for the coming summer. The German load can be covered with the available capacity. Even under severe conditions Germany is therefore not expected to be dependent on interconnectors to maintain adequacy.

A longer hot and dry spell could lead to restrictions of power plant availability because of problems with cooling water supply or fuel transporting problems due to low river levels.

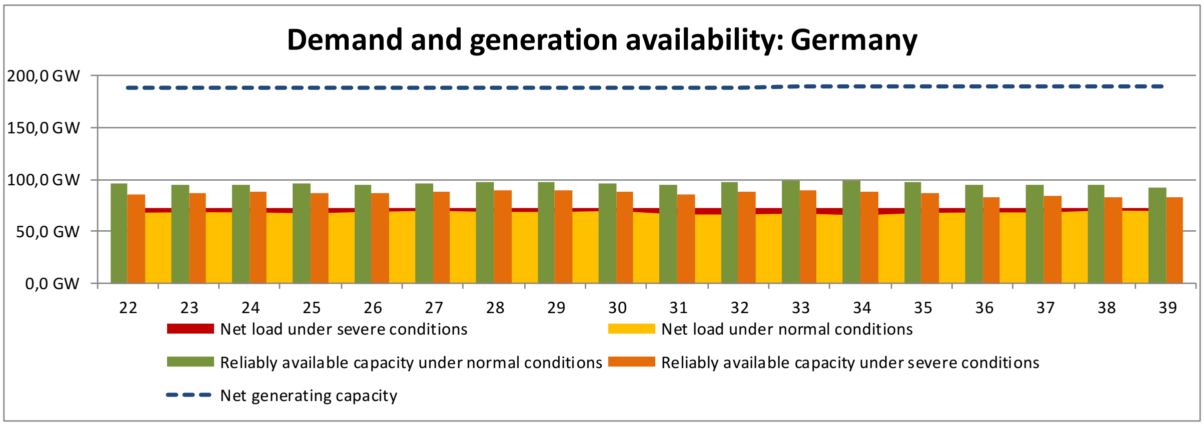
Extensive conventional power plant unavailability abroad can also have effects on the situation in Germany.

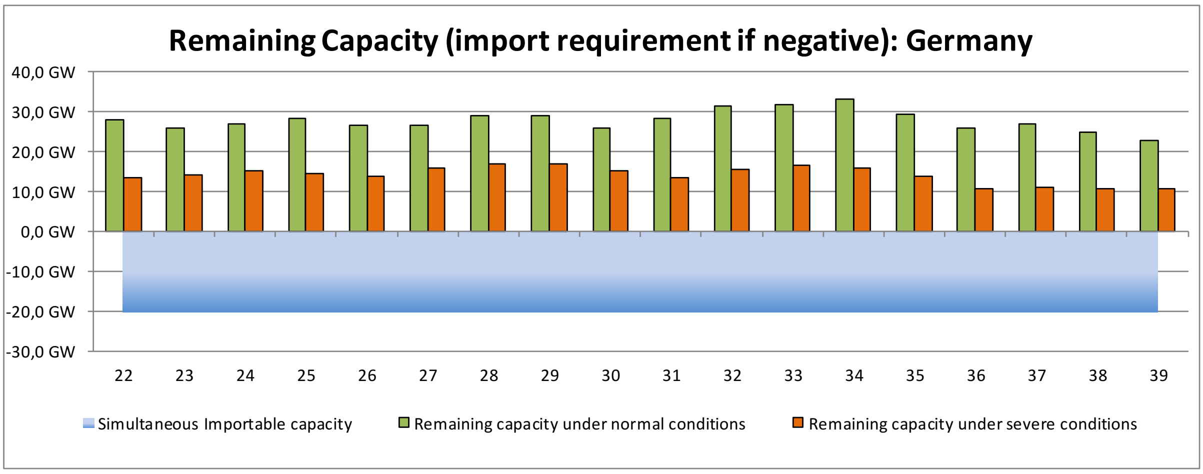
Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

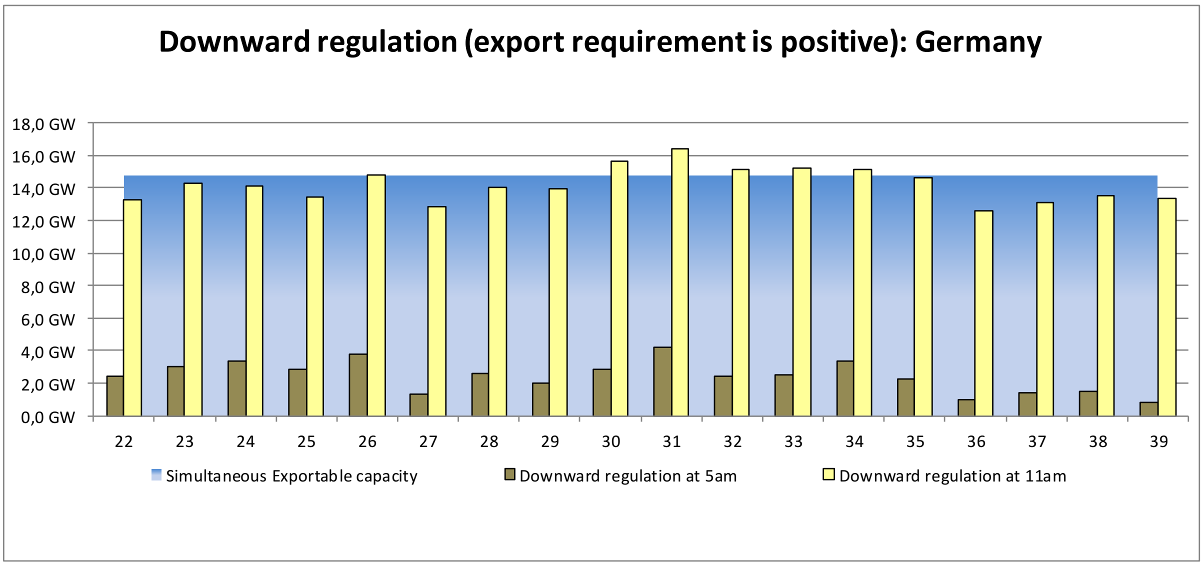
No critical periods for maintaining adequacy are expected.

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

Possibly the increasing PV infeed could lead to unexpected load flows in the German transmission system. Especially if the RES infeed in the north of Germany is high and low in the south. Specifically, the time around Whitsunday could be critical concerning voltage problems in case of low demand, no PV infeed in the south of Germany but a moderate infeed of wind energy. In periods with high renewable infeed and low (regional) demand high power flows on interconnectors are expected. Situations might occur in which regional infeed management is necessary to solve overload problems. Still, no critical situations are expected.


Demand and generation availability: Germany
200,0 GW
150,0 GW
100,0 GW
50,0 GW
0,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
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
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Downward regulation (export requirement is positive): Germany
18,0 GW
16,0 GW
14,0 GW
12,0 GW
10,0 GW
8,0 GW
6,0 GW
4,0 GW
2,0 GW
0,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Great Britain

The British TSOs expects:

- high levels of maintenance in Week 27 and 28, due to more Coal units on planed outages;
- low hydro levels in Week 31, 32 and 33 due to the number of hydro units on planed outages.

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

For the **Normal condition**, remaining capacity is negative in week 38. Therefore, the British TSOs would require some imports from France or Netherlands to meet the demand.

Although the remaining capacity forecast is negative in week 38, there are many means which can improve the situation:

a) imports from Interconnectors will help bring negative values to positive;
b) generation plant will proactively react to tight margin in those weeks, by moving planned outages so that the demand and reserve can be met;
c) advanced commercial trading of generation, interconnectors and other measures can be arranged to help meet demand in those tighter weeks;
d) system services reserve (3GW as submission) could be used to meet demand in real-time

If the position could not be rectified by trading or if the outage pattern remains the same and the demand could not be met, a Notification of Insufficient System Margin (NISM) warning would be issued. This notification is used inform the market and to encourage an increase in available generation or reduction in demand.

Under **severe conditions**, the remaining available capacity is negative in weeks 27, 28, 35~39 (the worst week is Wk38). Therefore, the British TSO would require imports from France or the Netherlands to meet demand.

a) In extreme cases e.g. if wind is less than 6% and the temperature is less than 8 °C in September (i.e. week 38), then the situation could potentially be very tight even with maximum imports from France and the Netherlands. However, the probability of such weather conditions is **very low**.

b) Even if such conditions were to occur, there are still several options available to meet demand. These include using some of the 3GW system services reserve, which have been excluded from this assessment, but could be used to meet demand in real-time. We may also expect to see a response from the market that could result in some imports from Irish interconnectors, or generators shifting outages.

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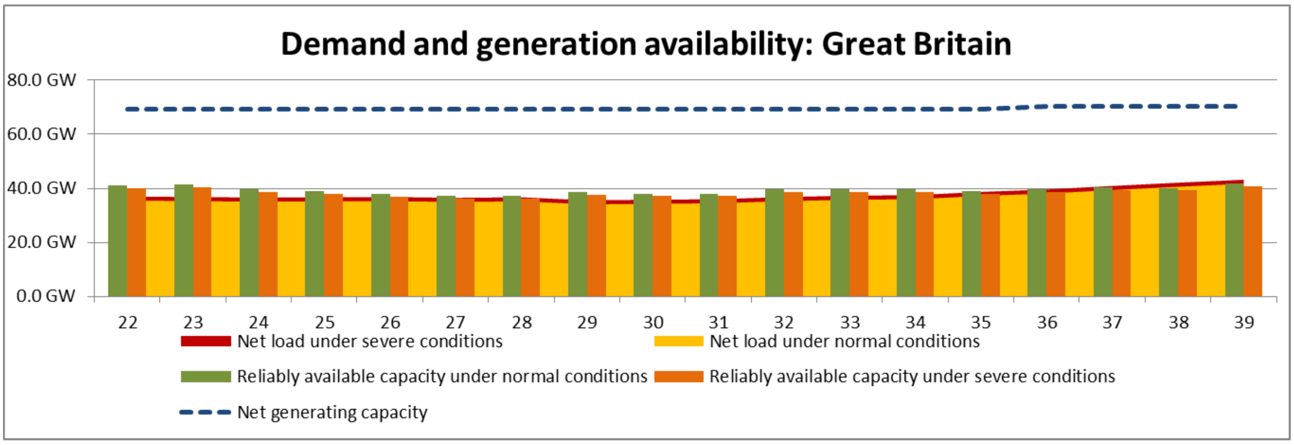
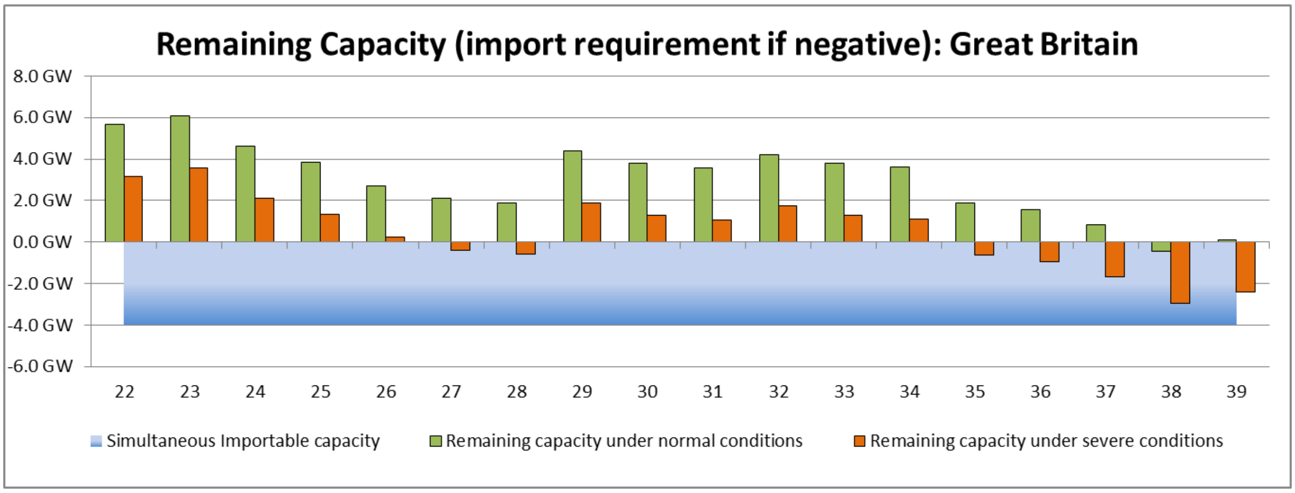
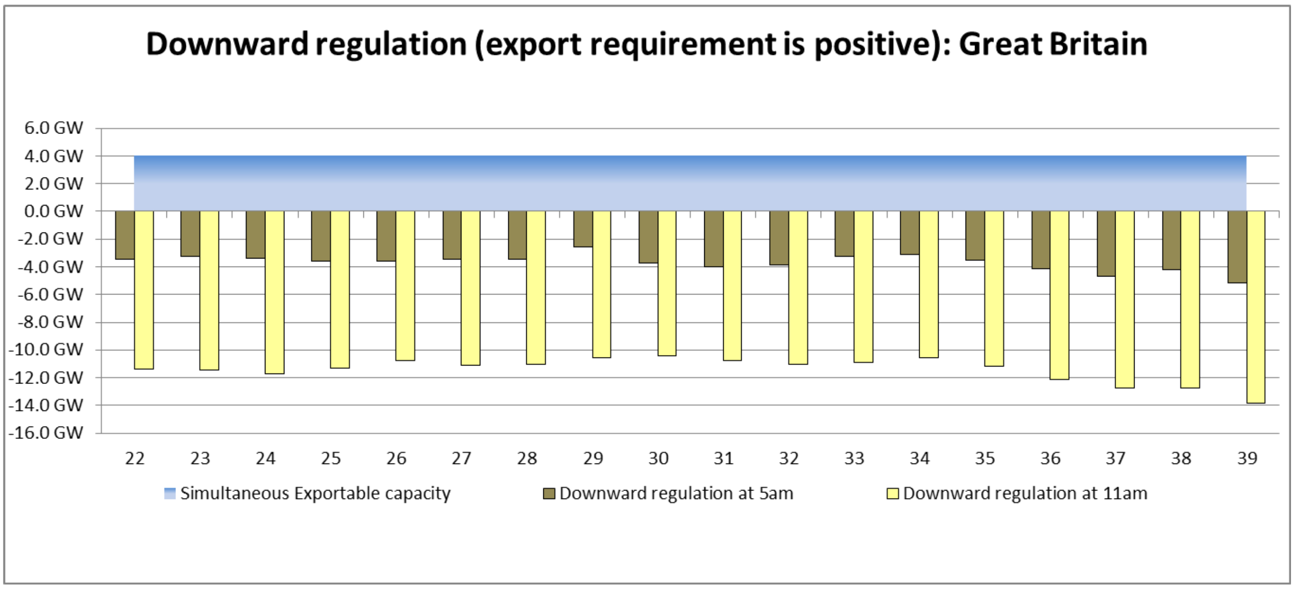

Demand and generation availability: Great Britain
80.0 GW
60.0 GW
40.0 GW
20.0 GW
0.0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity


Remaining Capacity (import requirement if negative): Great Britain
8.0 GW
6.0 GW
4.0 GW
2.0 GW
0.0 GW
-2.0 GW
-4.0 GW
-6.0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Downward regulation (export requirement is positive): Great Britain
6.0 GW
4.0 GW
2.0 GW
0.0 GW
-2.0 GW
-4.0 GW
-6.0 GW
-8.0 GW
-10.0 GW
-12.0 GW
-14.0 GW
-16.0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Greece

The Greek system is expected to be in balance in the upcoming summer period (2016). The level of indigenous national generation the good hydraulic storage of hydropower stations ensure the adequacy and security of the Greek interconnected System, which is not threatened under normal and severe weather conditions and there is no planning for high level of maintenance during this summer. Moreover the water reserves are expected to be at least at the last year's level.

In very warm periods during the summer, fire events can affect the transmission capacity.

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

The most critical period during summer is the first half of July, due to maximizing of the demand, annually.

The role of interconnectors currently is not important for generation adequacy due to decrease of the demand the last years.

The interconnections can play a significant role especially in periods with large variations in System demand. In this cases IPTO could export or import energy to/from other countries depending of the market prices.

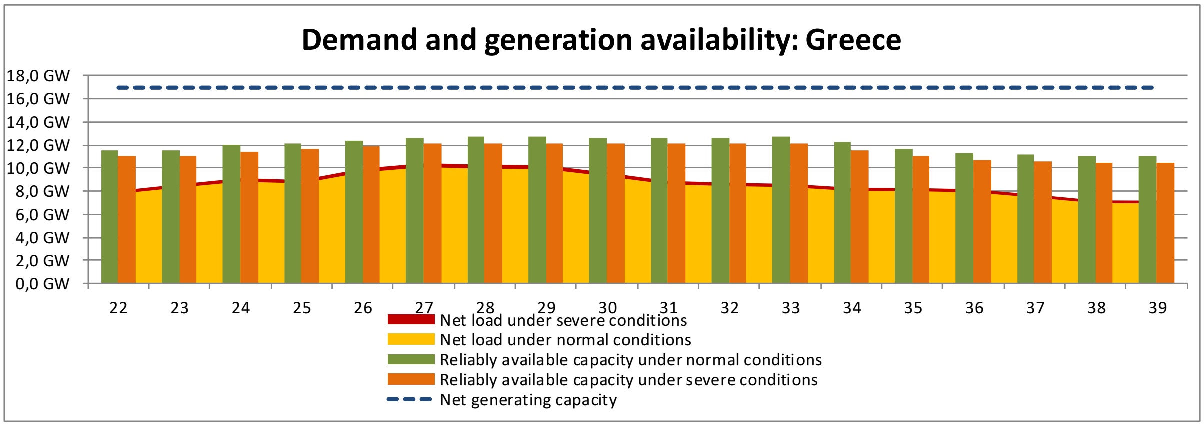
Most critical periods for downward regulating capacity, countermeasures adopted and expected role of interconnectors in managing an excess of inflexible generation

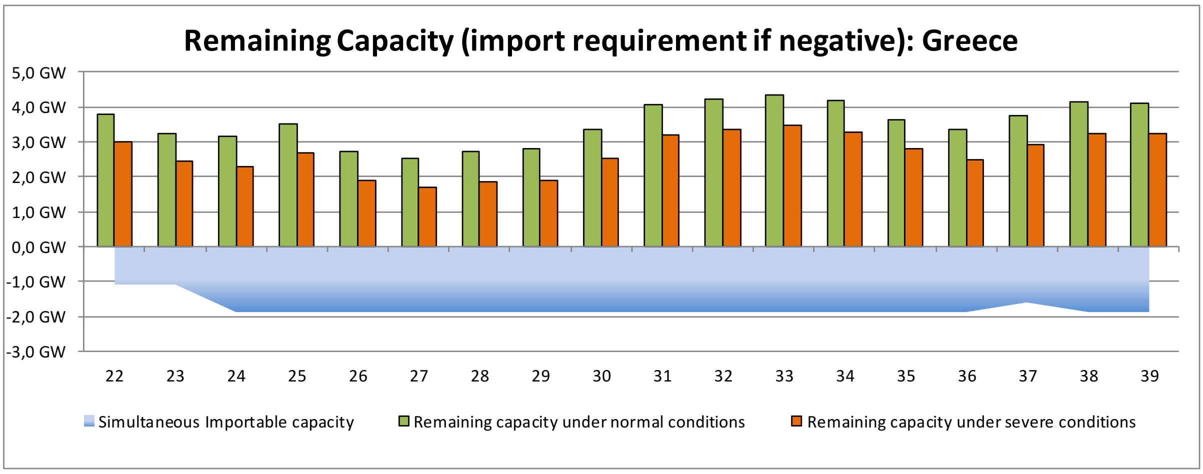
The most critical periods for downward regulating capacity are usually from 00:00 to 06:00 local time (due to low demand) and from 11:00 to 17:00 (due to high PV production).

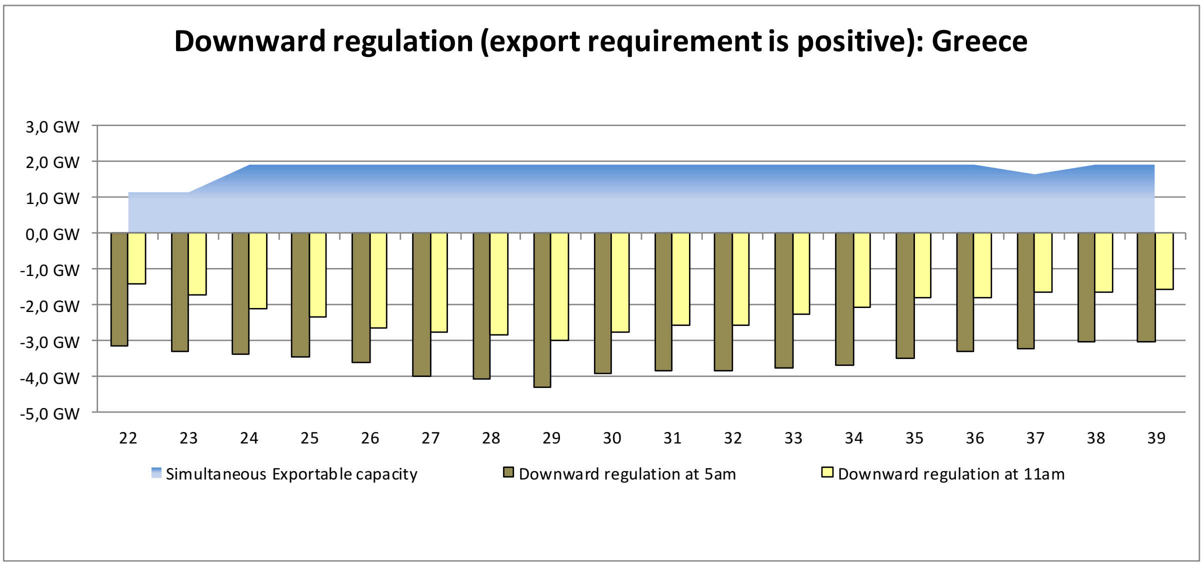
The countermeasures adopted are:

- request of sufficient secondary downward reserve.
- use of Pump Units.

The interconnectors are not used for reserve exchange.


Demand and generation availability: Greece
18,0 GW
16,0 GW
14,0 GW
12,0 GW
10,0 GW
8,0 GW
6,0 GW
4,0 GW
2,0 GW
0,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
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): Greece
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
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Downward regulation (export requirement is positive): Greece
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
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Hungary

In accordance with the constantly growing demand, there is no period of time when the import could be ignored. The unavailable capacity is increasing, which strengthens the dependence on the import.

The most critical periods can be caused by the severe weather conditions in June and July, since the units are temperature dependent.

After liberalisation, import is mainly an issue of the traders, available interconnection capacity is satisfactory. Access is possible via yearly, monthly, daily and even intraday capacity tenders, auctions. The only limitation is due to high transit flows through the interconnections.

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

The level of maintenance is relatively high during the summer; it is mainly between 500 and 1000 MW, which is about 5-10% of the Hungarian installed capacity. The most critical periods are the weeks of June, when the level of maintenance is over 1000 MW.

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

There are not any critical periods because of the nearly constant value of minimal demand, must run generation and downward regulating reserve. Because of the listed reasons the downward regulation value is constant, which can be decreased by the growing solar capacity.

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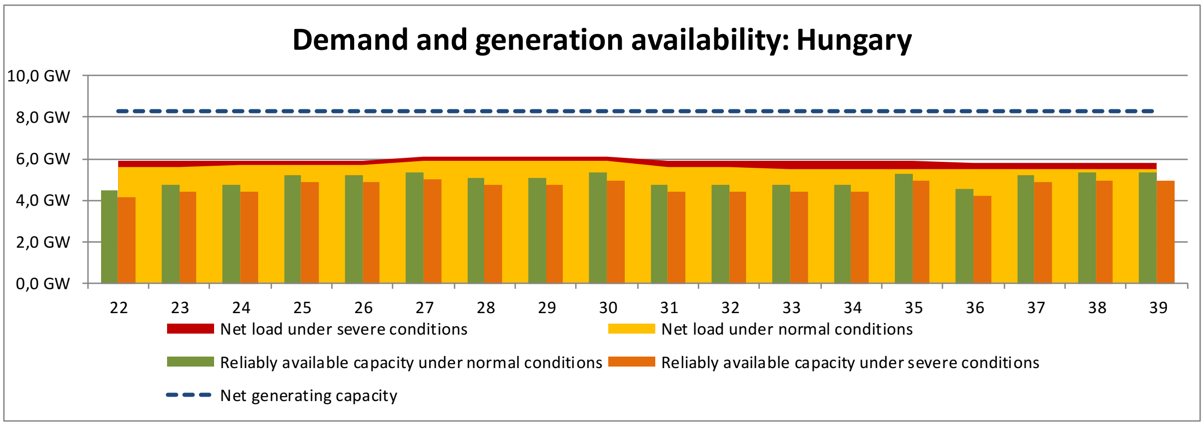
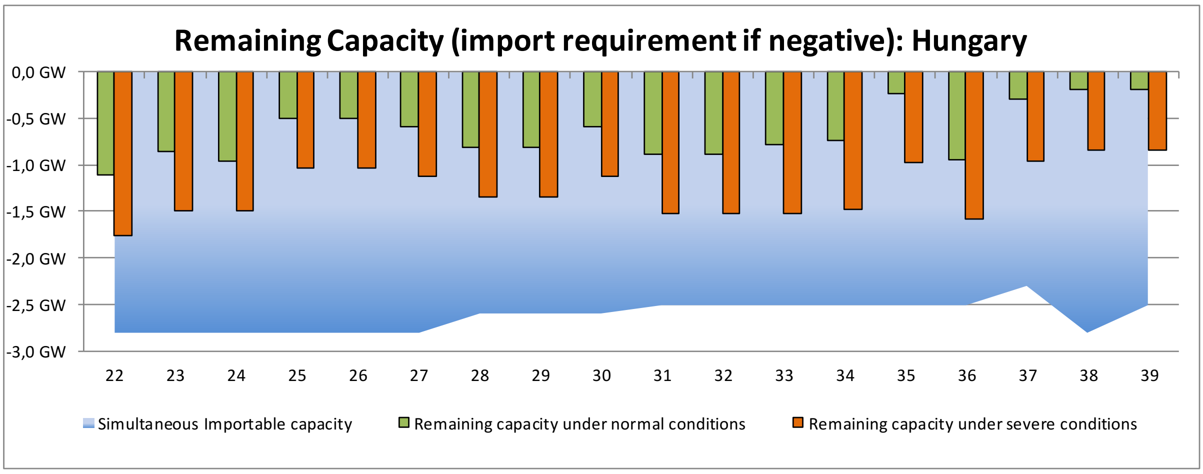
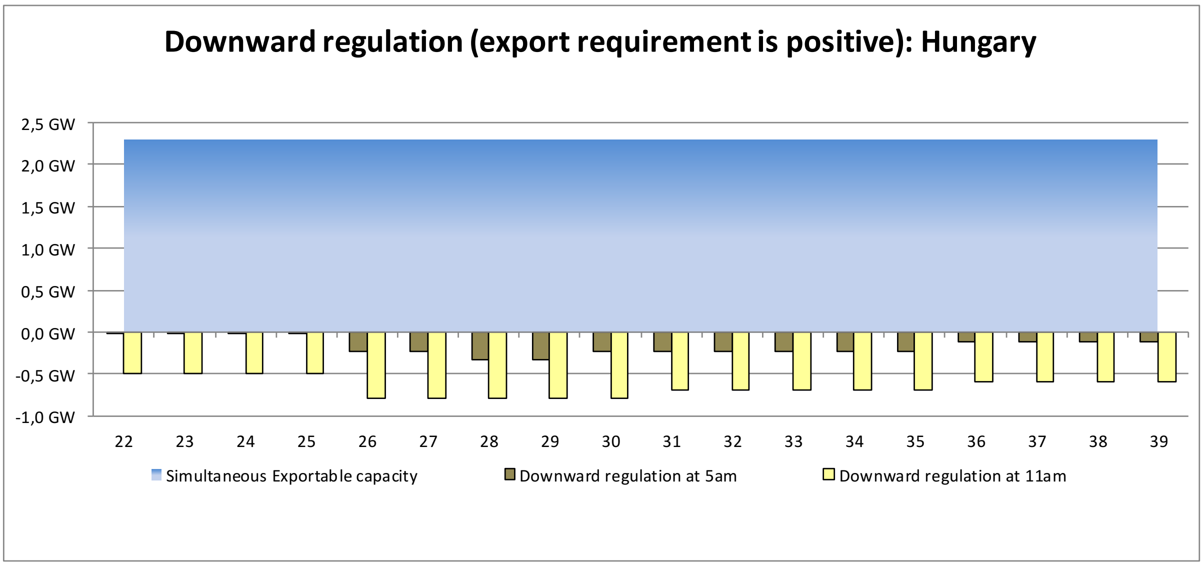


Demand and generation availability: Hungary
10,0 GW
8,0 GW
6,0 GW
4,0 GW
2,0 GW
0,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity



Remaining Capacity (import requirement if negative): Hungary
0,0 GW
-0,5 GW
-1,0 GW
-1,5 GW
-2,0 GW
-2,5 GW
-3,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions



Downward regulation (export requirement is positive): Hungary
2,5 GW
2,0 GW
1,5 GW
1,0 GW
0,5 GW
0,0 GW
-0,5 GW
-1,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Iceland

The generation capacity in Iceland is expected to be sufficient to meet peak demand this summer under normal as well as severe conditions. Landsnet does not anticipate any particular problems in the isolated Icelandic power system.

The installed generation capacity connected to the Icelandic transmission system is approx. 2.7 GW, of which 77% is hydro based and 23% based on geothermal energy. No new generating units are expected this summer.

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Ireland

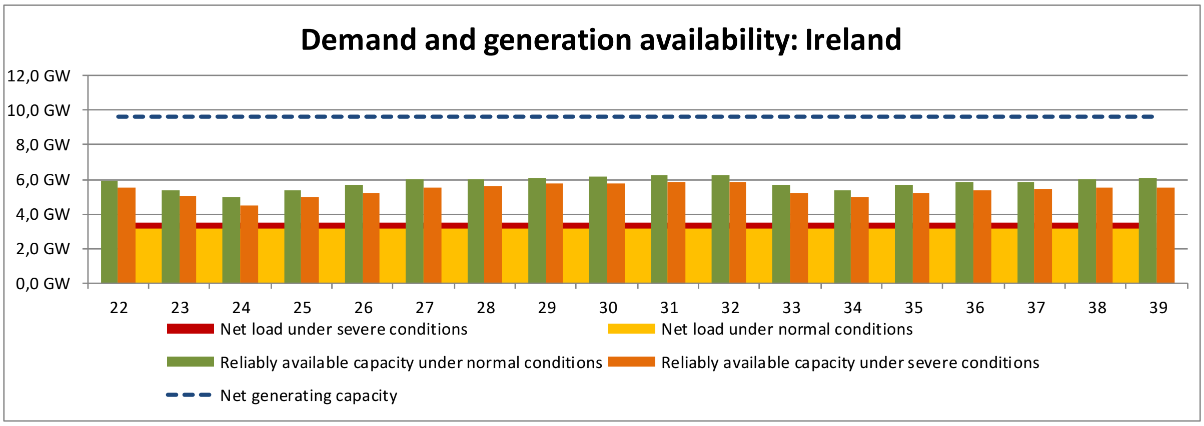
EirGrid does not expect any capacity or demand issues on the Ireland system this summer. According to the latest analysis, there will be sufficient capacity to meet the demand over the summer period. There is sufficient spare capacity to deal with unexpected forced outages.

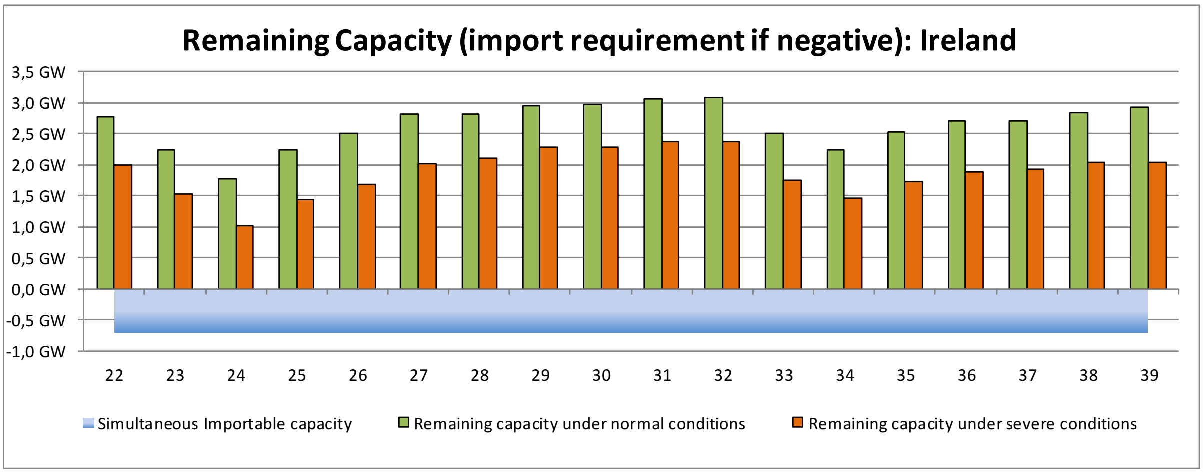
Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

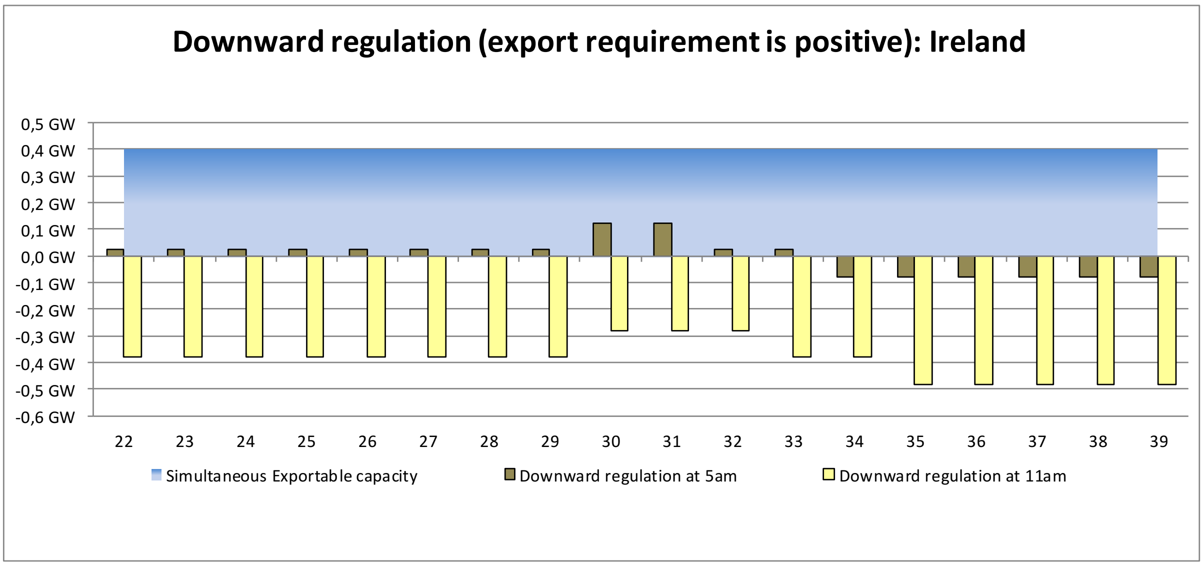
The most critical period will be in week 24 when there will be 1.5 GW or 16% of the available capacity on scheduled outage.

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

Downward regulating capacity is not expected to be an issue as wind power is curtailed where needed.


Demand and generation availability: Ireland
12,0 GW
10,0 GW
8,0 GW
6,0 GW
4,0 GW
2,0 GW
0,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
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
3,5 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
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Downward regulation (export requirement is positive): Ireland
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
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Italy

In normal conditions, margins are expected to be comfortable across the whole summer period, with high PV infeed during daytime and with available conventional generation capacity that is expected to be able to cope well with the evening peak load.

Under severe conditions remaining capacity expected in the summer could become negative during July, and import from neighbouring countries could be necessary to cover the peak load.

In Sicily, until the commissioning of the new cable with the mainland (expected in late June) that will tenfold the interconnection capacity of the island, some adequacy problems could also occur.

The probability of a "dry scenario", with reduced hydro availability and problems with thermal power plants water cooling (scenario that can worsen the situation), is under continuous assessment.

There are some other risk factors such as:

- lack of adequate downward regulating capacity: high renewables production (wind and solar) during low load periods and decreasing of electricity demand on the national power grid recorded during the last periods, taking into account the level of the other inflexible generation, could lead to a lack of adequate downward regulating capacity;
- voltage regulation problem and congestions: high voltage problems can arise especially in the south due to low load, reduced flows along EHV and high renewable production. Market and physical congestion, especially from South to North, will be common during the summer.

In order to cope with this risks Terna prepares preliminary action and emergency plans and, in case of need, adopt the appropriate countermeasures (e.g. avoiding planned maintenances during periods with high load, or, during high renewable/low load periods, adopting enhanced coordination with DSO and special remedial actions, such as the curtailment of inflexible generation, and other special actions, such as some NTC reductions, could be planned in cooperation with neighbouring TSOs).

In order to update the electricity demand sensitivity to air temperature, it was considered:

- hourly loads data for working days updated at 2014-2015;

- for normal condition: average of temperatures in the last 50 years taking into account Pan-European data base;
- for the severe condition: the sensitivity of load to temperature of the heating zone, updated with the data of the year 2014-2015.

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

The worst period for maintaining adequacy in severe conditions is from week 28 to week 32, while for the downward regulation is expected to be the week 33 (mainly due to the bank holiday on the 15 August).

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

During high renewable/low load periods, in order to guarantee the system security Terna could adopt special remedial actions, such as the curtailment of not flexible generation and some NTC reductions, to be planned in cooperation with neighbouring TSOs. In some situation could arise the need of reducing the import of energy or, in extreme case, of exporting to the neighbouring countries.

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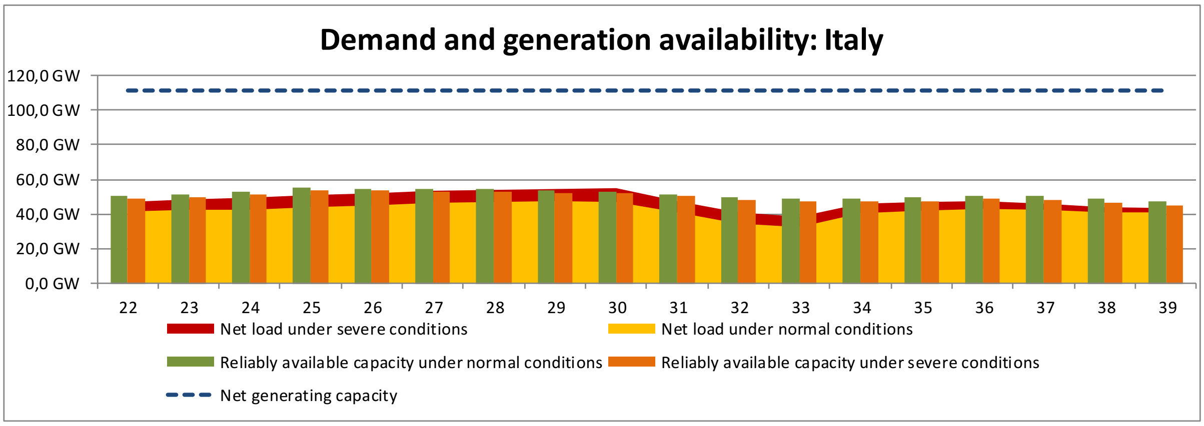
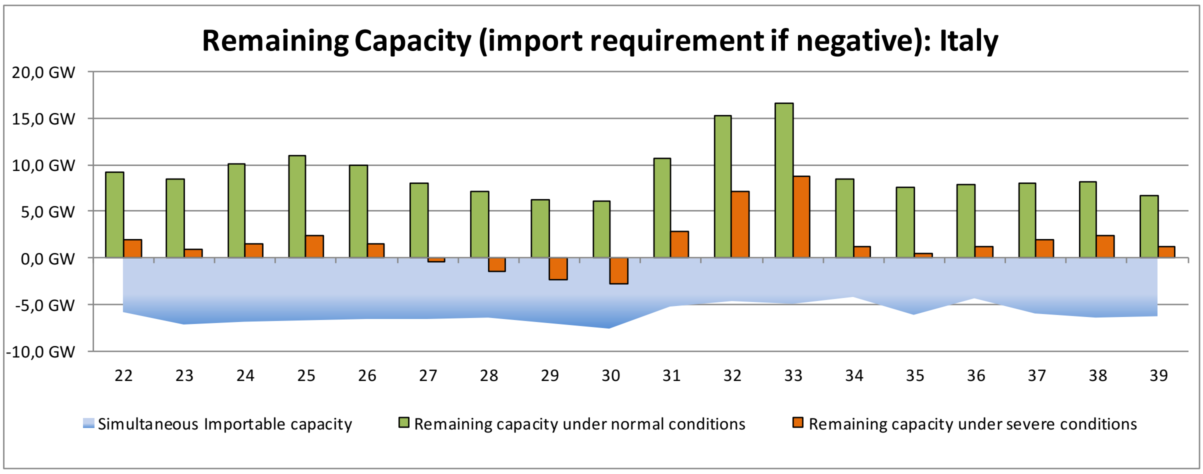
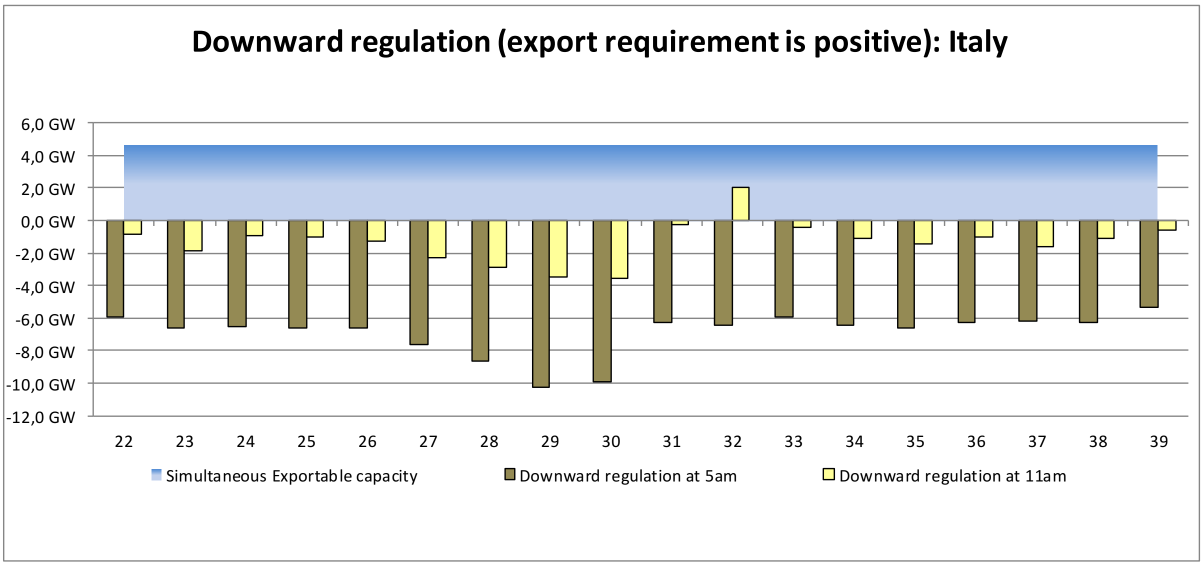

Demand and generation availability: Italy
120,0 GW
100,0 GW
80,0 GW
60,0 GW
40,0 GW
20,0 GW
0,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity


Remaining Capacity (import requirement if negative): Italy
20,0 GW
15,0 GW
10,0 GW
5,0 GW
0,0 GW
-5,0 GW
-10,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Downward regulation (export requirement is positive): Italy
6,0 GW
4,0 GW
2,0 GW
0,0 GW
-2,0 GW
-4,0 GW
-6,0 GW
-8,0 GW
-10,0 GW
-12,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Latvia

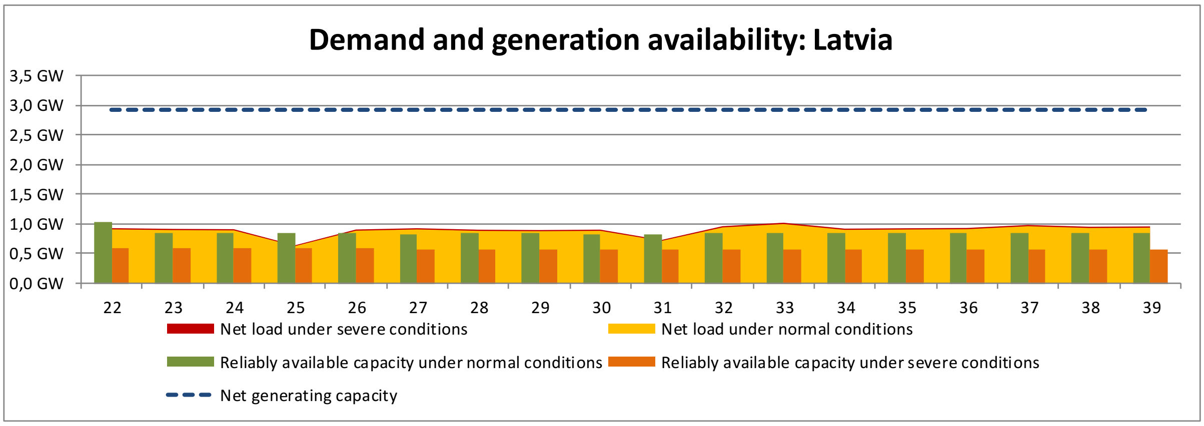
During the summer period one of both units of Riga CHP2 is in maintenance (420 MW) and also the reconstruction works for some hydro turbines in Daugava hydro power plant are scheduled. During the summer under normal conditions the available capacity of hydro generation for peak load is 200 MW, but in the severe conditions the hydro generation is expected around 150 MW (dry year, very low water inflow), due to this the import from neighbouring countries is expected. No restrictions on gas import.

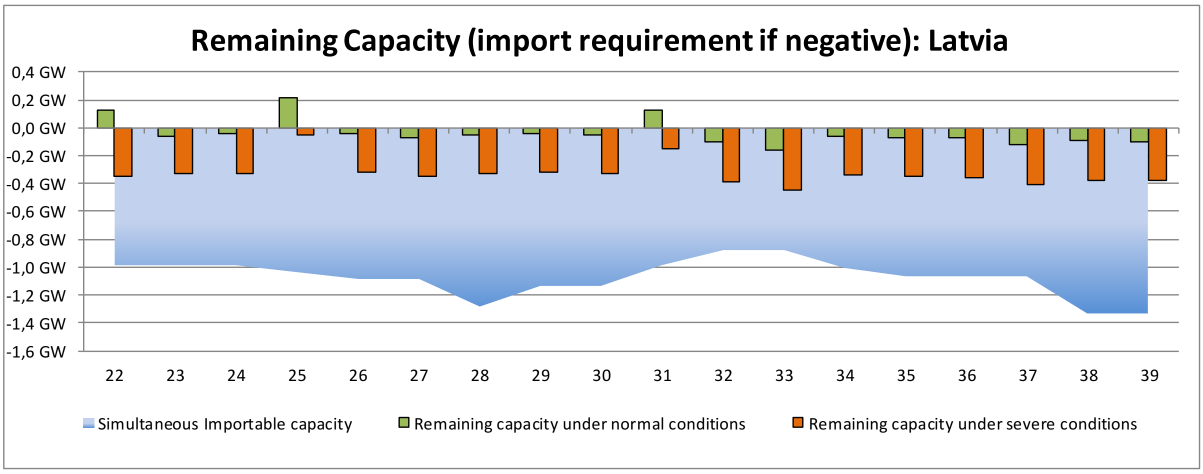
Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

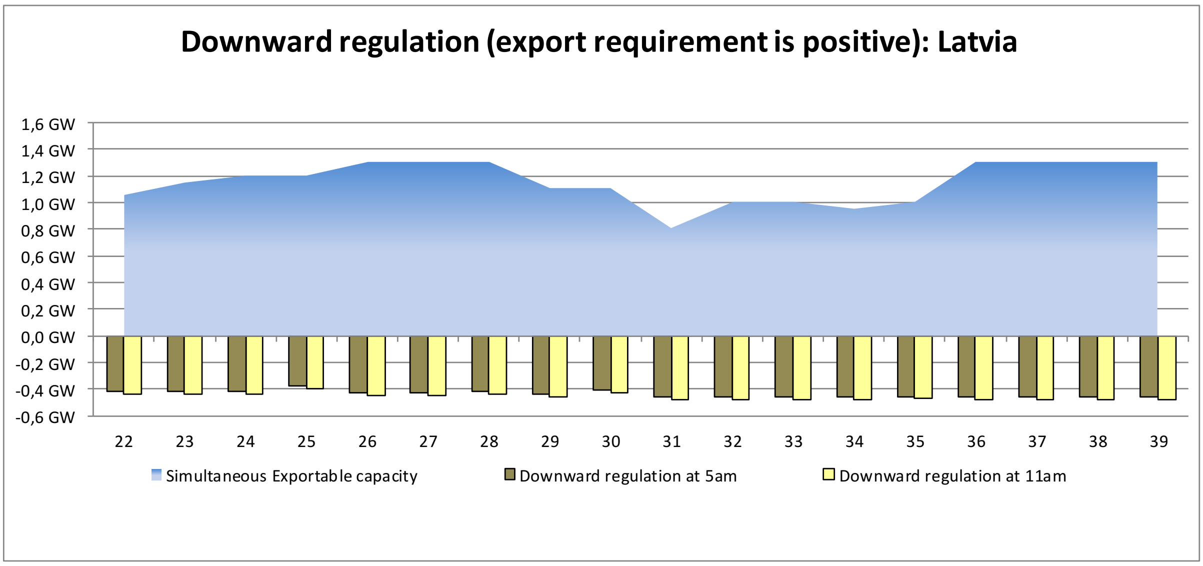
Almost all summer period reliable available capacity under normal conditions cannot cover a peak load except weeks 25 and 31. In the severe conditions reliable available capacity can't cover a peak load during whole summer period. Latvian TSO will rely on cross-border capacities with neighbouring countries.

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

The cross-border capacity for electricity import from Estonia will be around 600 MW and for the export to Estonia around 420 MW. The cross-border capacity for electricity import from Latvia will be around 460 MW and for the export to Latvia around 740 MW. The cross-border capacities allow maintaining downward regulating capacity. Latvian power system has also tie-line with Russian power system, but the trading import and export amounts with Russia is regulated through Lithuania/Belarus cross-border and all exchanges are going via Nord Pool Spot power exchange.







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Lithuania

The load estimation for normal conditions was based on statistical data of previous years, therefore no major increase is expected. For the coming summer season, the maintenance schedule in general is not intensive. According to the maintenance schedule the largest generation inaccessibility (9% of NGC) will be on 23 week.

Due to both high capacity of system services (29% of NGC) and generation unit maintenance the deficit adequacy level is expected in Lithuanian power system on the week 23 for severe conditions. Deficit adequacy level at reference point may reach up to 0.1 GW.

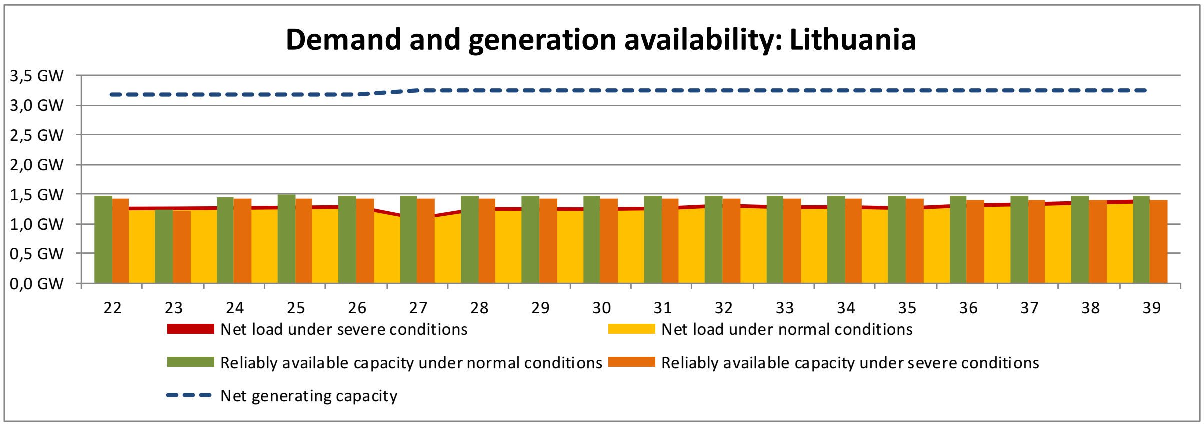
Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

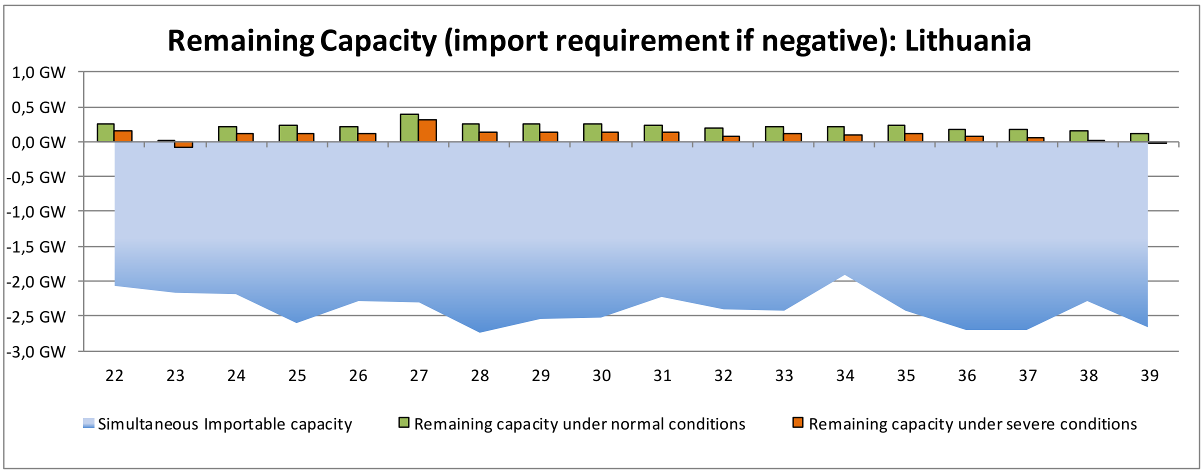
From system adequacy point of view capacity of interconnectors does not play an important role for Lithuanian PS because available generation capacity is sufficient to cover system demand. However, available generation is usually not competitive in the wholesale market, therefore large amount of Lithuanian PS demand is covered by imported electricity.

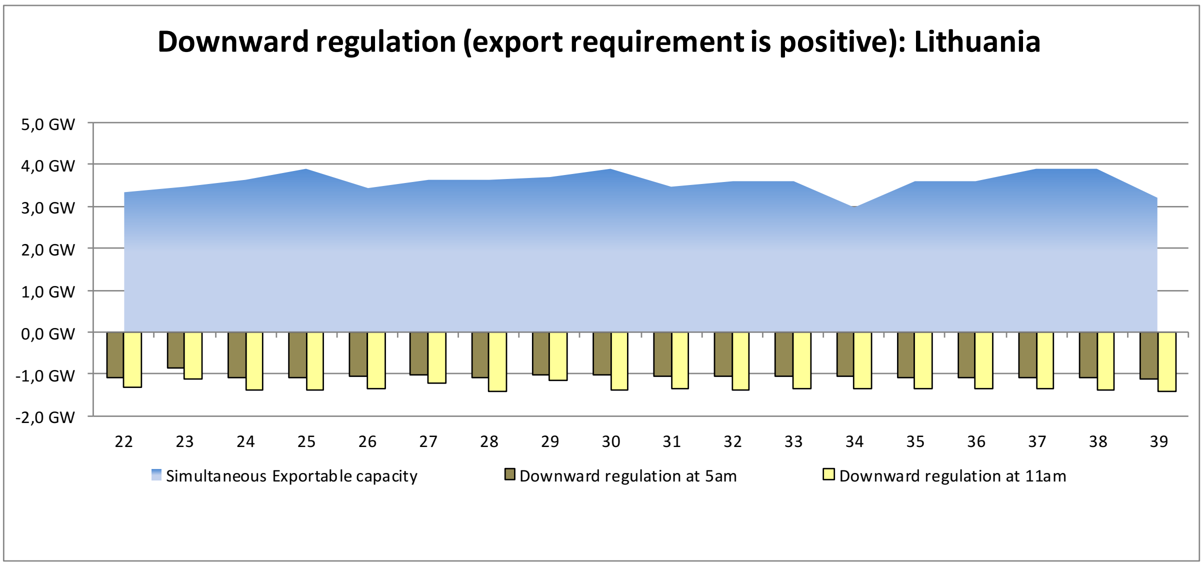
All import volume from third countries (Russia, Belarus) based on power flow calculations and allocated at Lithuania-Belarus interconnection highly depends on Estonia-Latvia interconnection capacity which is reduced during summer period because of higher ambient temperature and planned maintenance activities on the interconnection lines. That causes significant import restrictions from third countries to Lithuanian PS for whole summer period. Import ability of Lithuania PS also depends on available generation in Kaliningrad region. Import restrictions are foreseen during weeks 22-26 and 37-38 when generation of Kaliningrad TPP will be reduced because of maintenance activities. Another more significant restriction of importable capacity will be in week 34 due to planned maintenance of HVDC interconnection with Poland.

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

Lithuania is the importing country with increasing amount of installed renewables (24% of NGC). Onshore wind NGC will increase by 71% (from 290 to 495 MW) on 2016 year in comparison to 2015. All interconnection capacities are foreseen to be used to manage an excess of inflexible generation.







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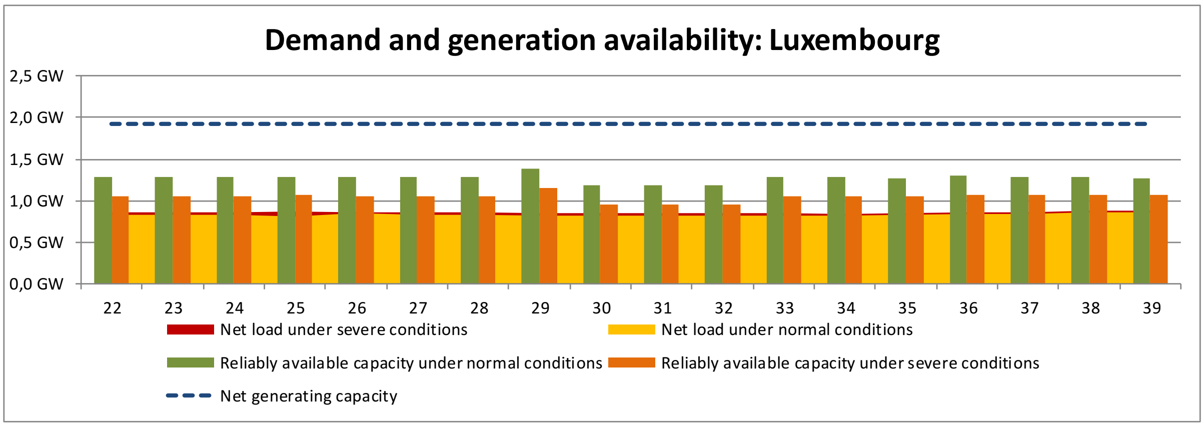
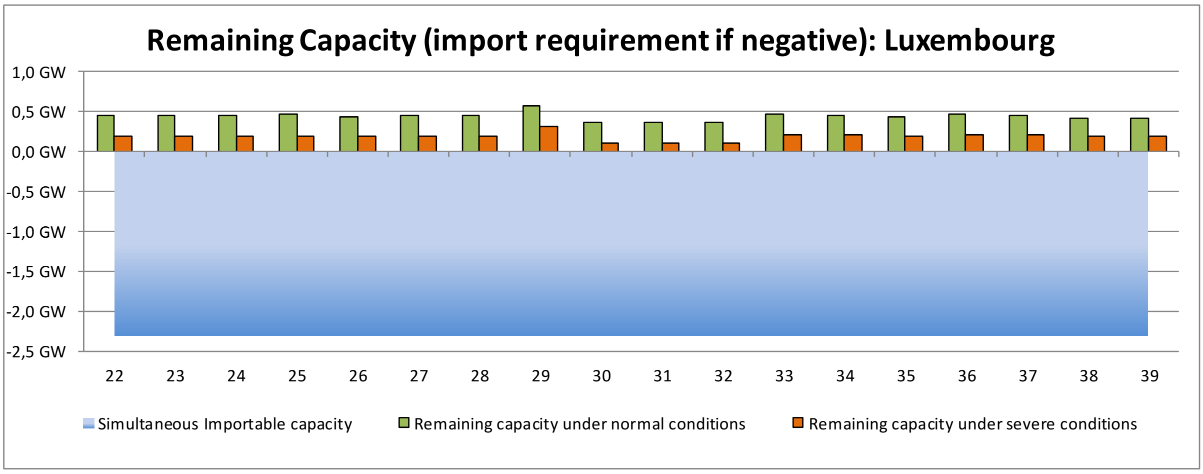
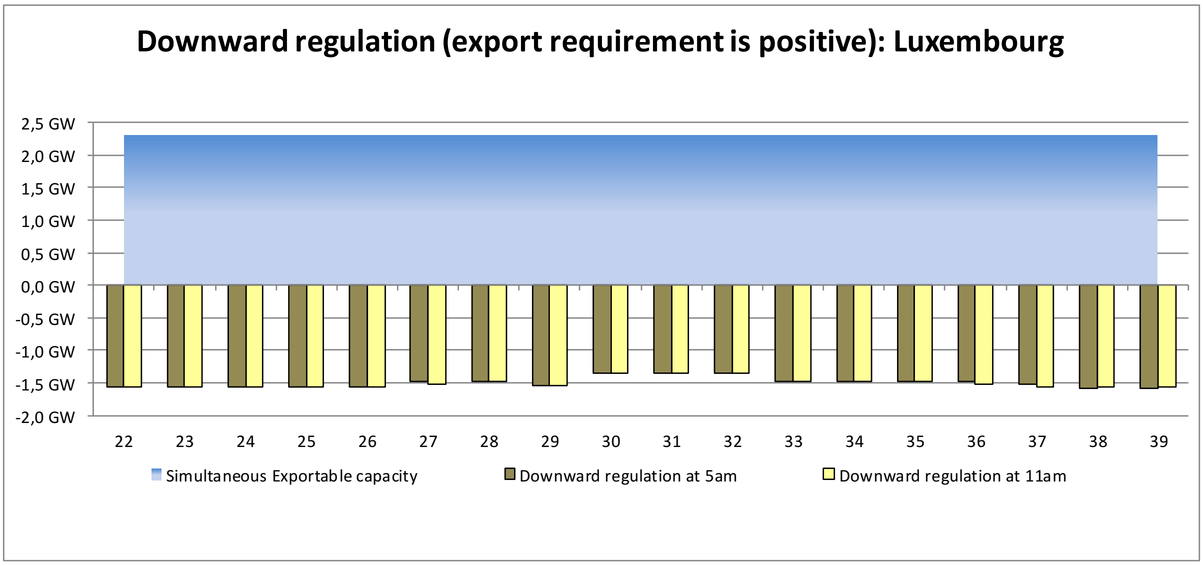
Luxembourg

Compared to the situations of the previous years, there should not be major impacts in Luxembourg.

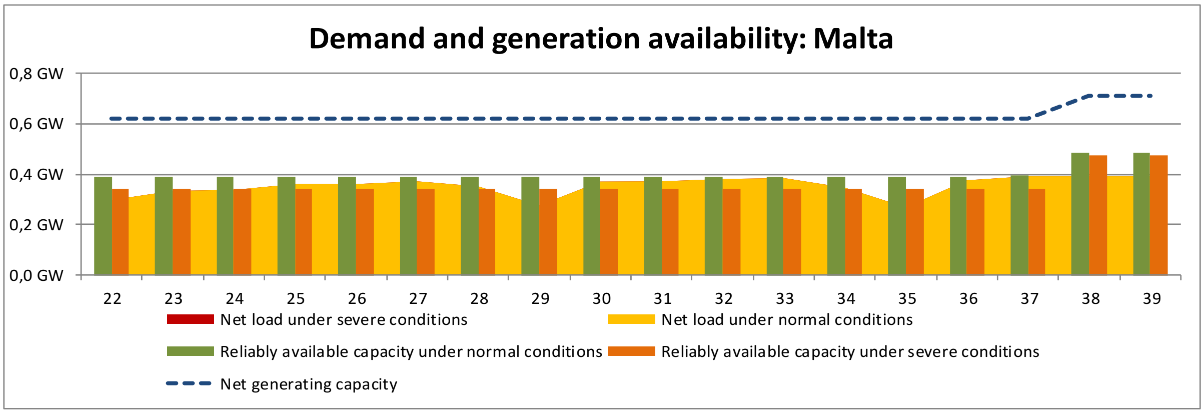


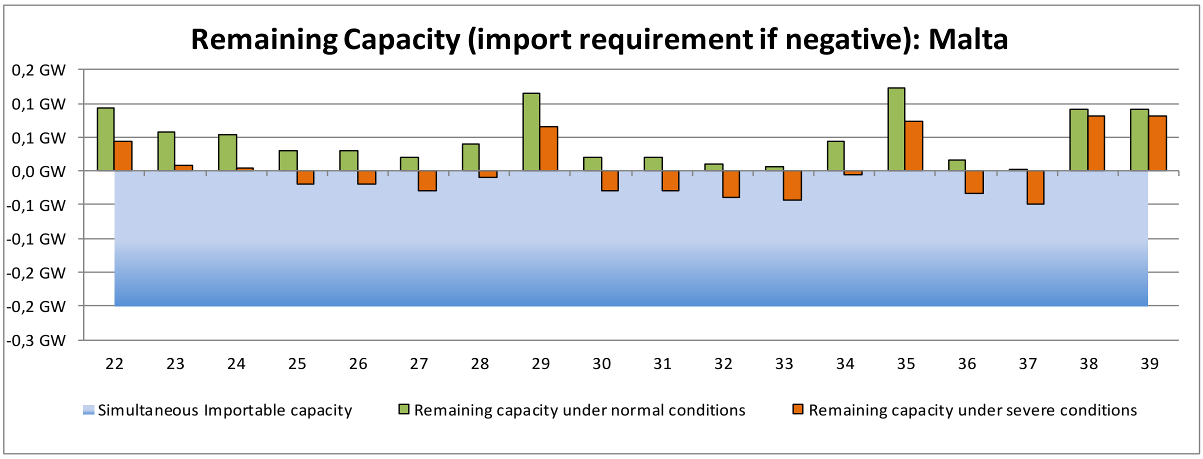


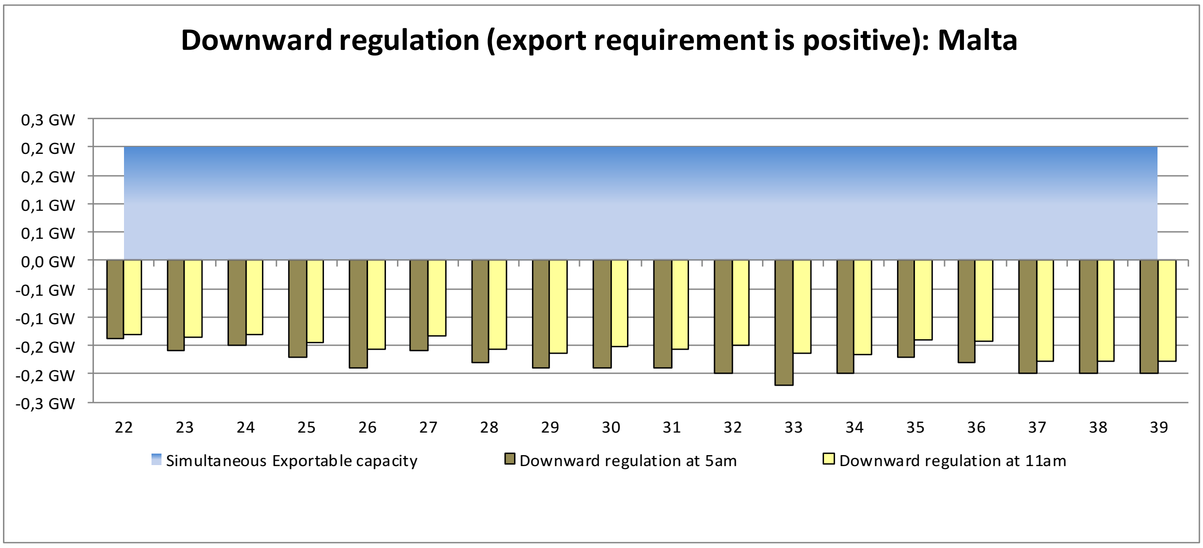


Malta

During the covered period the conversion of the diesel engines plant from heavy fuel oil to liquefied natural gas will be implemented. Hence half of the plant will not be available..







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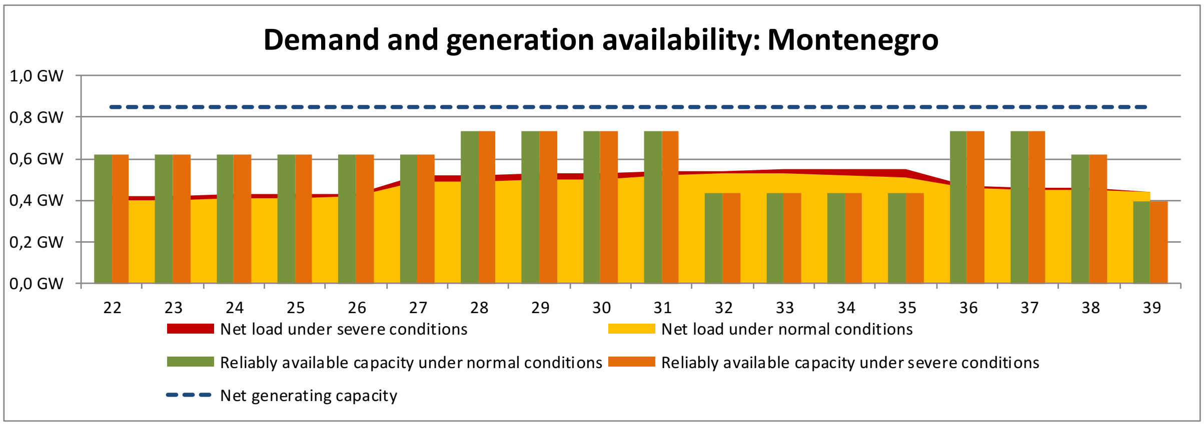
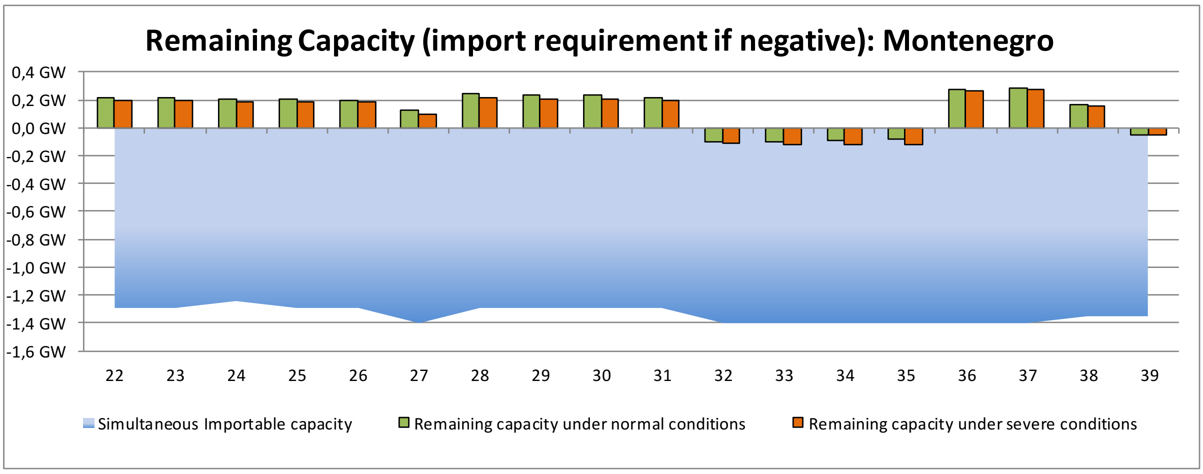
Montenegro

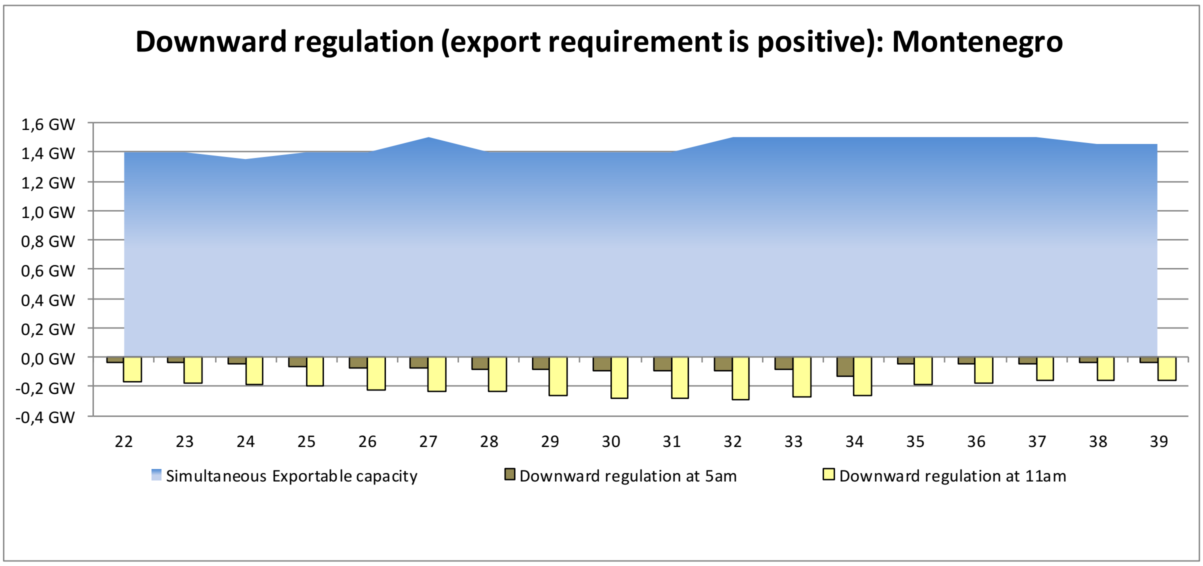
The main stressed period could be in August. The main factor can be high demand and bad hydrological conditions. Also due to high influence of aluminium and steel industry on Montenegrin power demand, some mistakes in demand prediction can be expected. Generation - load balance problems, under normal conditions, are not expected in the summer 2016. Difference between consumption and production in the critical periods will be covered with energy from import.

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

Most of maintenance and overhauls works are planned to be finished during the spring and beginning the summer period.

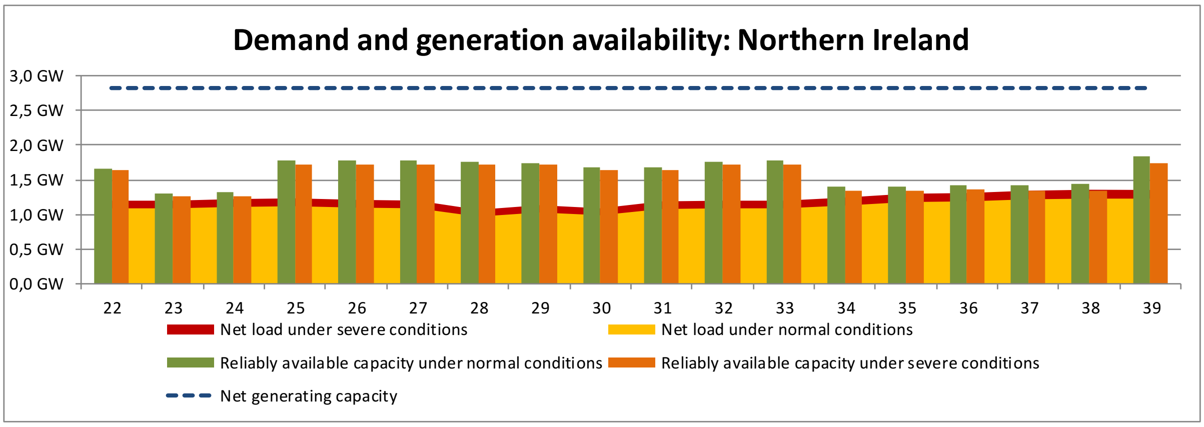

Demand and generation availability: Montenegro
1,0 GW
0,8 GW
0,6 GW
0,4 GW
0,2 GW
0,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity

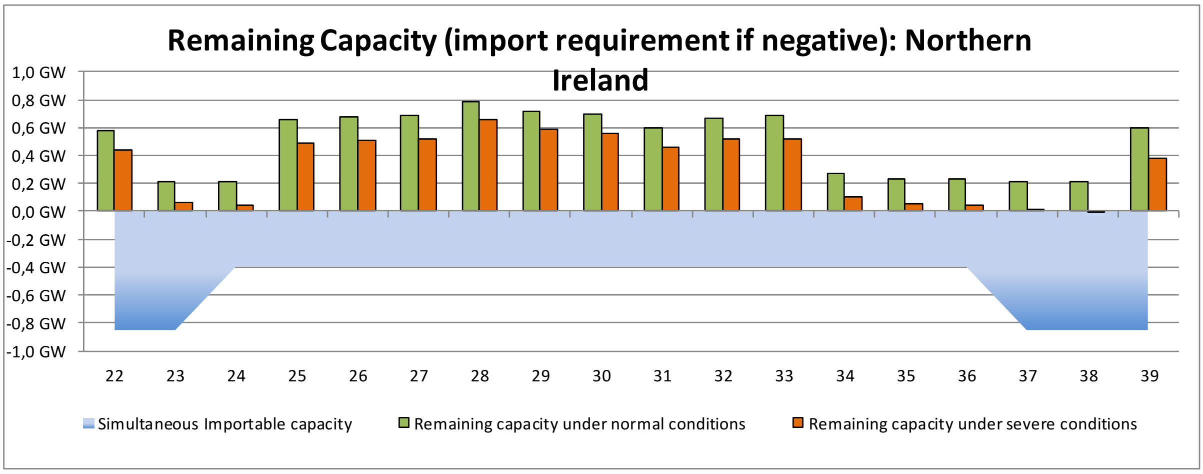

Remaining Capacity (import requirement if negative): Montenegro
0,4 GW
0,2 GW
0,0 GW
-0,2 GW
-0,4 GW
-0,6 GW
-0,8 GW
-1,0 GW
-1,2 GW
-1,4 GW
-1,6 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions

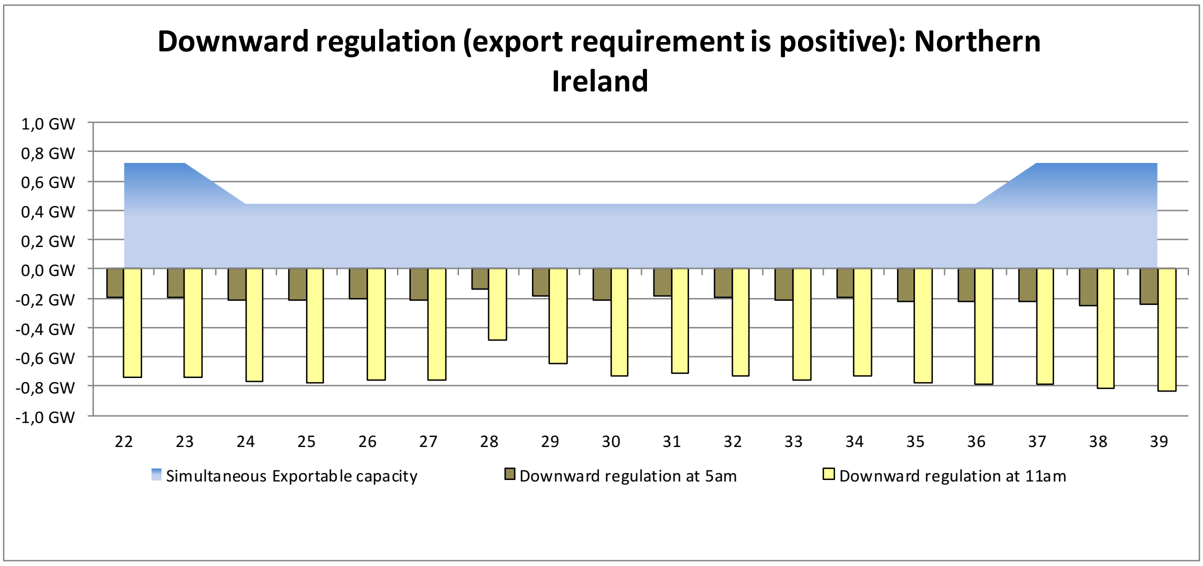

Downward regulation (export requirement is positive): Montenegro
1,6 GW
1,4 GW
1,2 GW
1,0 GW
0,8 GW
0,6 GW
0,4 GW
0,2 GW
0,0 GW
-0,2 GW
-0,4 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Northern Ireland

The Moyle Interconnector will be unavailable to Northern Ireland for approximately 16 weeks due to system outages in Great Britain. This outage is scheduled for the summer months.







Norway

Norway is normally self-supplied during the summer with a capacity surplus, also in severe conditions. It is expected that the demand will be higher than the inflexible generation, but in some areas it could get a surplus in some periods. Towards the summer period 2016 it is expected that the hydrological balance will be normal.

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

Statnett does not expect any critical situations for maintaining adequacy during the summer of 2016.

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

Statnett does not expect any critical situations for downward regulating capacity during the summer of 2016.

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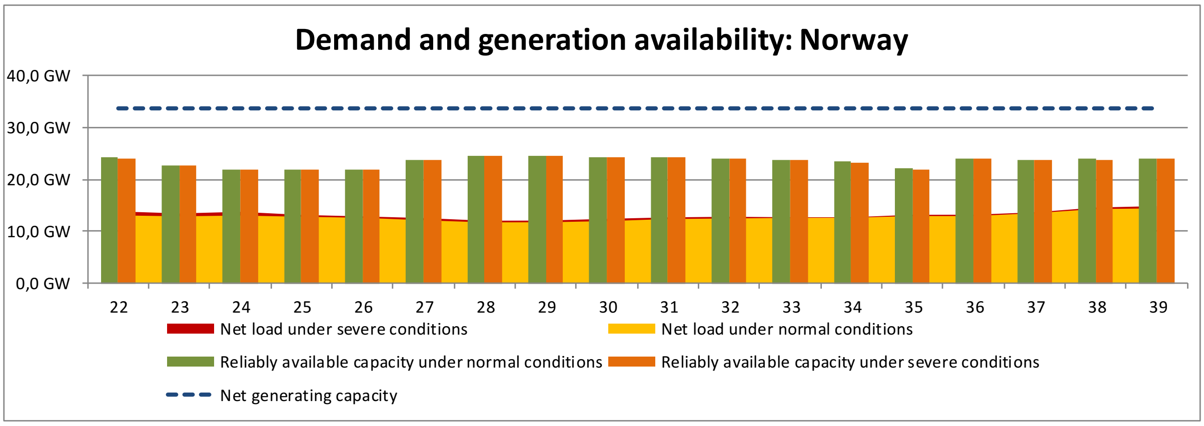
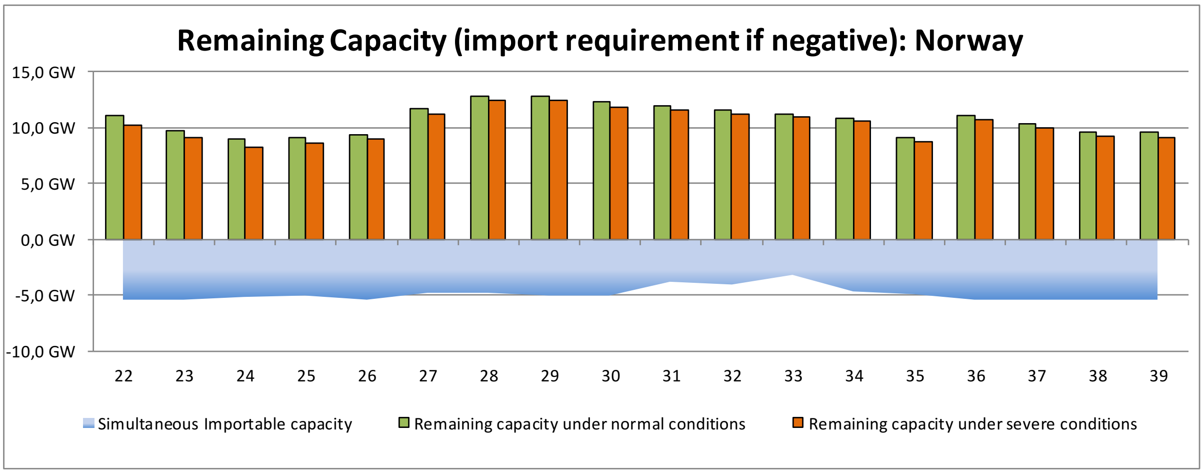
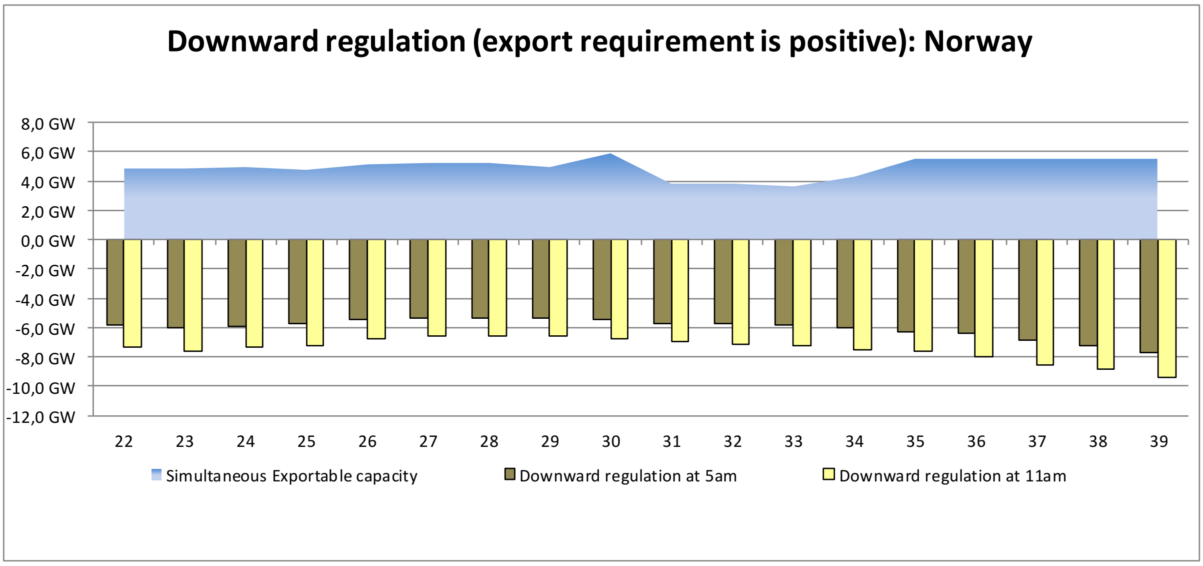

Demand and generation availability: Norway
40,0 GW
30,0 GW
20,0 GW
10,0 GW
0,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity


Remaining Capacity (import requirement if negative): Norway
15,0 GW
10,0 GW
5,0 GW
0,0 GW
-5,0 GW
-10,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Downward regulation (export requirement is positive): 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
-8,0 GW
-10,0 GW
-12,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Poland

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 the result of development of subsidized (thus attractive from the cross-border trading point of view) renewable energy sources in the northern part of Continental Europe (CE). PSE takes position, that currently there is no proper coordination of capacity calculation and allocation process in Continental East Europe (CEE), therefore very often the unscheduled flows from the northern part of CE to the south resulting from above-mentioned transactions cause a violation of the N-1 criteria. TSOs from CEE, in cooperation with TSOs from Continental West Europe (CWE) region, are currently working on implementation the Flow-Base Approach, which should allow for correct coordination of capacity calculation and allocation in whole CE.

These unscheduled flows are limiting import capacity towards Poland, which could not be offered to the market on synchronous profile (borders 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 commercial 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 often 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, realized according to the 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-costly remedial action.
2. Bilateral cross-border re-dispatch (CBR) between PSE and 50Hertz, realized according to the 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

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power plants located next to the PL-DE border) and the possibility to decrease generation in Germany, and can also be limited by physical flows between PSE and CEPS (in order not to have more congestion there). It is a costly remedial action.

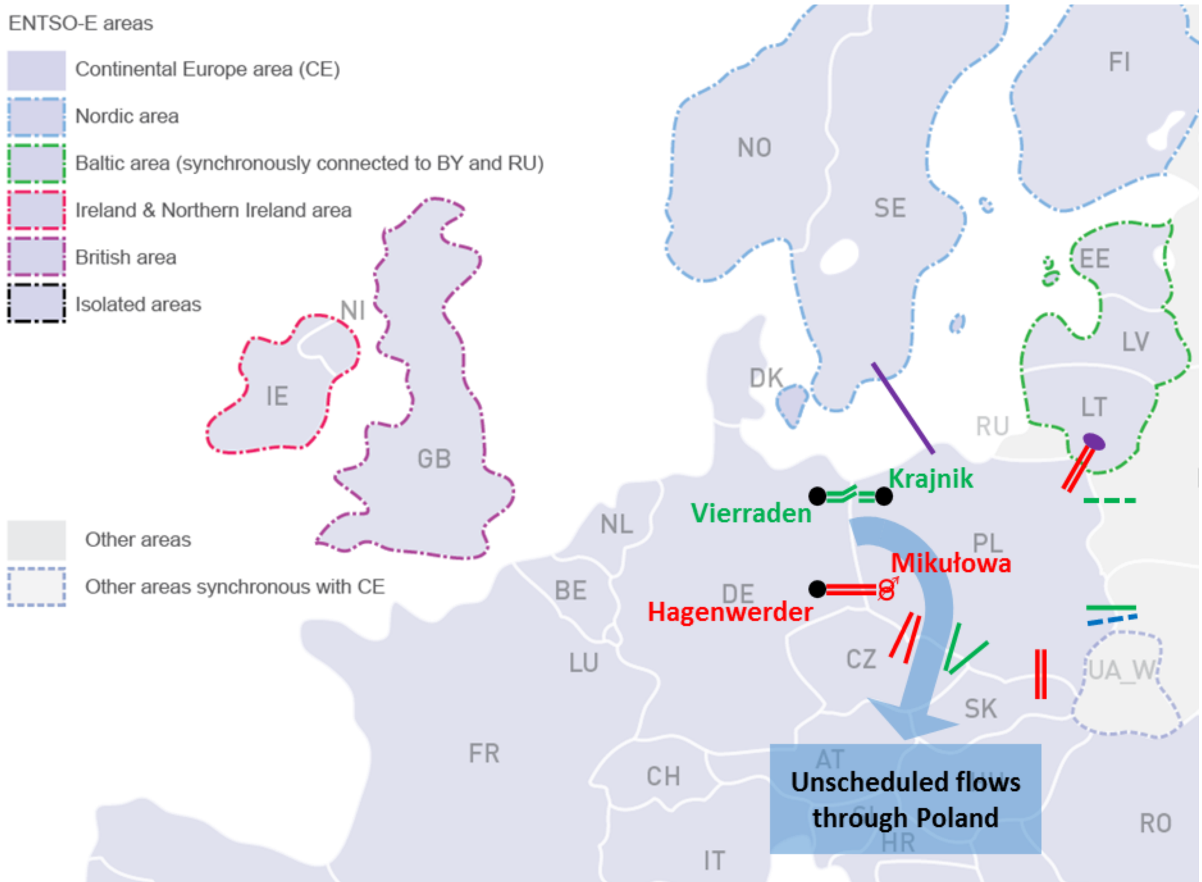
3. Multilateral re-dispatch carried out within the frame of Multilateral Remedial Actions agreement (MRA). The MRA agreement between TSOs in the TSC area (TSC-TSO Security Cooperation) was signed in June 2012, with regular updates ever since. This measure is used as a last resort to relieve German-Poland 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' control areas and the possibility of decreasing generation in Germany. It is a costly remedial action, with the highest cost of all measures.

PSE informed the European TSOs 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 (2015) part of Winter Outlook 2015/2016 report, such a case happened on Tuesday, 15 September 2015, when all available actions, which could limit unscheduled flows, were exhausted and the N-1 criterion was not fulfilled on the PL-DE border.

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). Due to fact, that the solution mentioned above will not be implemented before 2018 and having regards to possible generation shortage during severe conditions, PSE has asked TSOs in the TSO Security Cooperation (TSC) area to take an interim 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 (to avoid the risk of cascading trippings leading to Continental-wide splitting like 4 November 2006, with consequences that are difficult to assess). Unfortunately, progress on the above mentioned interim actions is too slow and insufficient for summer 2016. Regardless of these actions within TSC, PSE in cooperation with 50Hertz analysed other bilateral measures possible for timely application, which could reduce negative impact of unscheduled flows on interconnected system security.

Commissioning of PST in the Polish substation Mikułowa[22] is planned for May 2016. Due to the fact, installation of PST in the German substation Vierraden will not take place earlier than 2018 and taking into account situation occurred in Summer 2015 as well as tight power balance in Poland expected during severe conditions in summer 2016, there is a risk of insufficient remedial measures to manage unscheduled flows on PL-DE border. This risk is real and material, as proven on 15th September (n-1 not fulfilled for 4 hours). Having regarded this, PSE and 50Hertz agreed a special, temporary measure to disconnect the 220 kV line between Krajnik and Vierraden (one out of two double-circuit line connecting Poland and Germany) after the PSTs are commission in the Polish station Mikułowa:

[22] This is the first part of the PST investment project agreed by PSE and 50Hertz in February 2014. It foresees among other that PSE installs the PST in the Polish substation Mikułowa (in the PL-DE double circuit 400kV cross border line MIK-HAG), and 50Hertz installs the PST in German substation Vierraden (in PL-DE double circuit cross border line KRA-VIE). More details can be found in press release: "PST agreement"



It is expected that this special measure shall allow for effective utilization of the PST in the Polish substation Mikułowa in a situation where the PST in German substation Vierraden is not yet available. It will therefore allow for maintaining the secure operation of both transmission grids, even in situations causing so far high flows through the German-Polish interconnection and consequently high re-dispatch needs. More information can be found in common PSE and 50Hertz Press Release: "Disconnection of Krajnik-Vierraden line"

In addition steering the physical flow on the remaining Mikułowa-Hagenwerder line by PST operation is expected to allow for increasing commercial transmission capacities in the direction to Poland. Both TSOs intend to offer some cross-border capacity to the market in the Day-Ahead timeframe, based on technical analyses and operational experience

It is important to underline, that bilateral actions taken by PSE and 50Hertz can only decrease the negative impact of unscheduled flows but do not solve the origin of unscheduled flows problem – real sustainable solution to the problem 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).

Role of interconnections

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 above utilization of synchronous connections is strongly limited by unscheduled flows through Poland from the west towards the southern border. Described above special measure may allow increasing interconnection capacity on this profile based on technical analyses and operational experience, however due to fact, that this increase cannot be confirmed as sure, PSE (as in previous years) has provided to Summer Outlook 2016 0 MW of import capacity on whole DE+CZ+SK border.

Other Polish interconnectors in use are: DC cable with Sweden, 400kV double circuit line connected Poland and Lithuania (with back-to-back on Lithuanian side) and 220kV line with Ukraine, on which only import is possible (Ukrainian units can be connected synchronously to the Polish system).

As the 'best estimate of NTC' for Winter Outlook PSE provides a yearly forecast of NTC, which takes into consideration unscheduled flows through the PSE control area as well as includes network constraints caused by planned switching off of the cross-border and/or internal lines (or other elements).

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 forthcoming summer.

Severe conditions

Under severe conditions, PSE observes a negative balance for all analysed reference points, except for 3 ones in September. This is due to fact, that September peak load in Poland takes place in the evening, while reference point refer to 12:00 CET. In some of reference points, 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 ‘network conditions’). Extremely severe balancing conditions in the summer period may take place in case of long lasting heat spells leading to significant deterioration of Polish power system. 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 forthcoming summer may refer to hydrological constraints resulting from an extremely dry summer 2015 and its continuation into autumn and winter (low level of water in rivers used for cooling some thermal power plants).

The risk of high unscheduled flows through the Polish system (from the west to the south) during such weather conditions is high (or even can be higher, than in previous years) as a result of development of solar generation in Germany and high volume of market transactions. In such a situation, if necessary from power balance point of view (to recover minimum generating capacity reserve margin required), additional import on synchronous profile towards the Polish system can be realized under the condition of simultaneous multilateral re-dispatch action, MRA (with source and sink respectively south and west of Poland) taken at the same time to limit the unscheduled transit flows through the Polish system. It is estimated that ca 300 MW of such a re-dispatch (assuming source in Austria and sink in Germany) is necessary to allow 100 MW of import to Poland from Germany. A relevant framework for such a remedial action has been developed recently within TSC project. 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. Such situation happened on 15th September 2015 and was described precisely in Summer Review 2015 part of Winter Outlook 2015/2016 report. On the other hand usage of mentioned above measure is more probable than previous summer due to implementation of special topology measure on PL-DE border describe in paragraph “Network condition”.

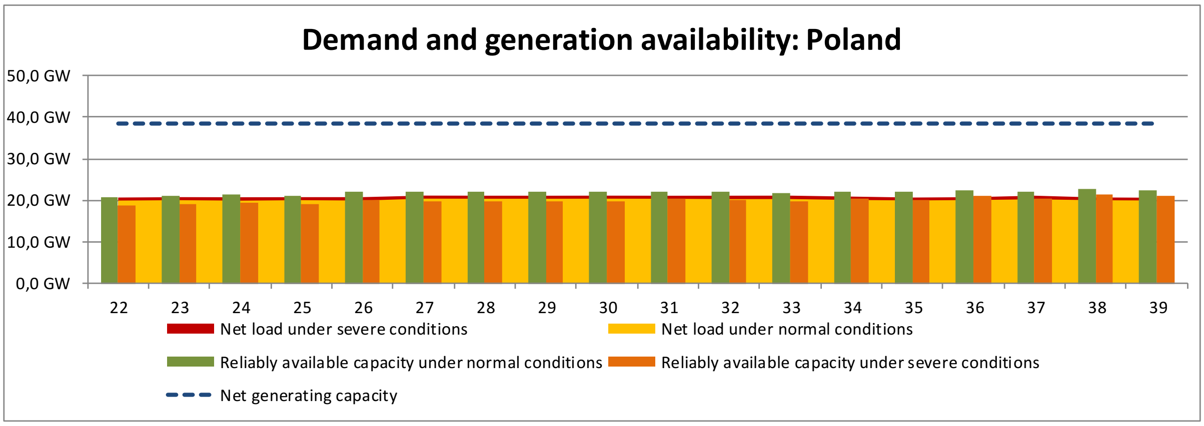
Most critical periods for downward regulating capacity, countermeasures adopted and expected role of interconnectors in managing an excess of inflexible generation

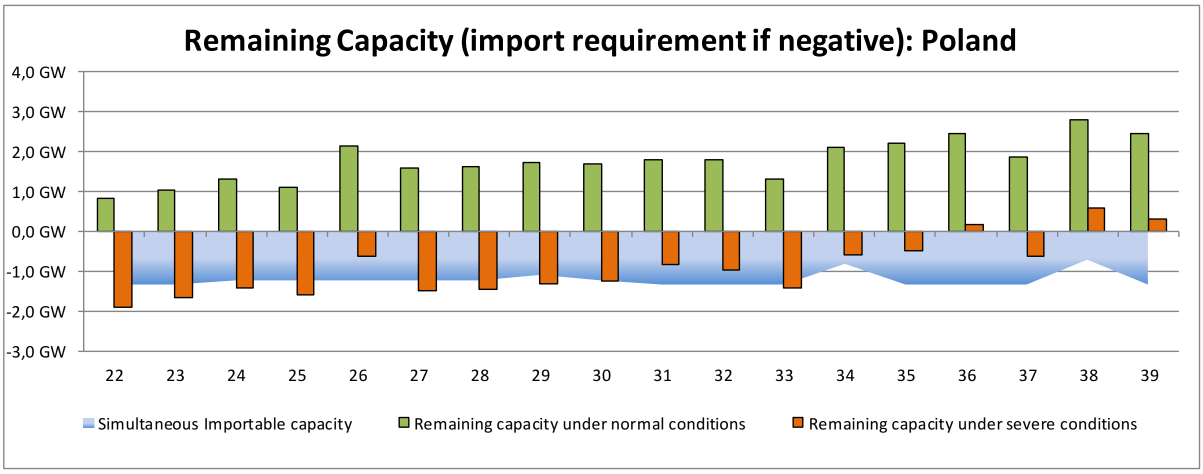
PSE does not prepare a forecast for downward regulation capabilities in yearly and monthly horizon (only during daily planning), so provided data is an estimate only. Based on this estimations PSE does not expect problems with renewable infeed at 5:00 and 11:00 a.m. in Sundays. Solar generation is not a problem because the NGC of solar is negligible in the Polish balance.

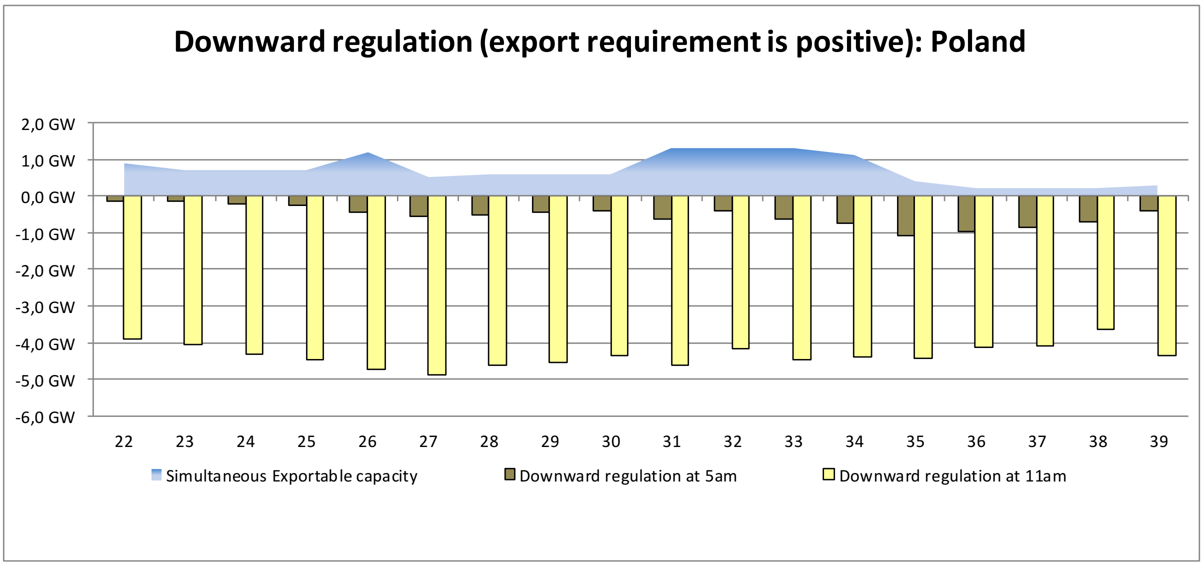
Short description of the assumptions for input data

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 Summer 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 cannot be compared directly.







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Portugal

REN's outlook for the upcoming summer season is positive, as conditions are favourable to system adequacy. Hydro storage is actually in 85% of its maximum capacity (beginning of March) and thermal generating capacity is expected to be fully available during the traditionally high demand period of July's mid-end. Since last summer, hydro and pumping capacities were reinforced in about 900 MW, so system's operation should perform in an even more comfortable level.

Downward regulation capability of the system also reveals a sufficient margin to deal with periods of high wind and low load.

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

Downward regulating capacity is substantially constant throughout the whole season, without critical periods.

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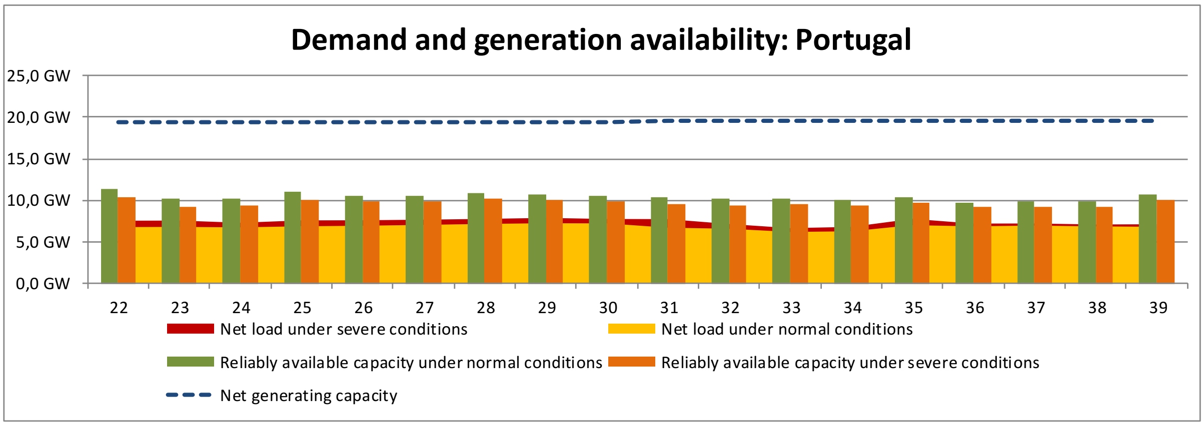
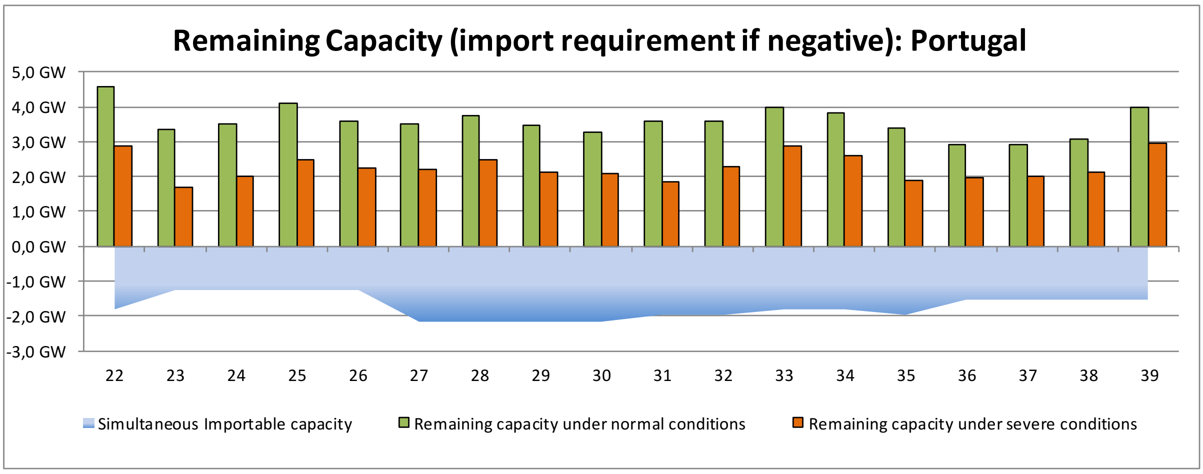
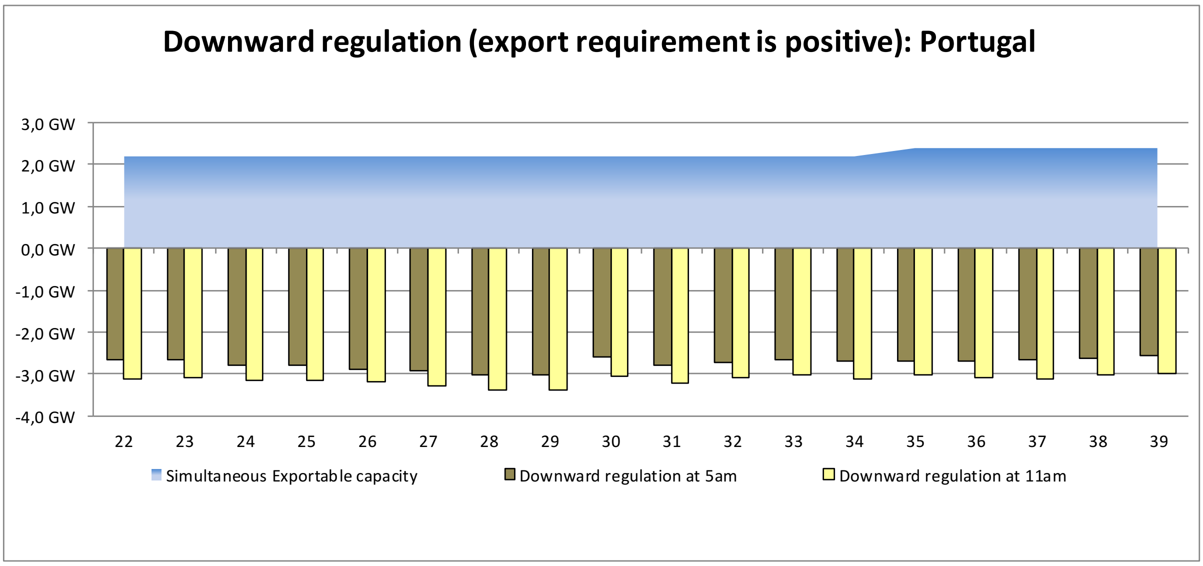

Demand and generation availability: Portugal
25,0 GW
20,0 GW
15,0 GW
10,0 GW
5,0 GW
0,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity


Remaining Capacity (import requirement if negative): Portugal
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
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Downward regulation (export requirement is positive): Portugal
3,0 GW
2,0 GW
1,0 GW
0,0 GW
-1,0 GW
-2,0 GW
-3,0 GW
-4,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Romania

The generation unit maintenance plan allows to cover from internal sources the national demand and the system reserves amount, in any time interval. During the summer 2016, we do not expect critical time intervals, even for heat wave circumstances, which may affect the system adequacy.

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

During the summer 2016, critical time intervals are not expected, even for heat wave circumstances.

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

During the summer 2016, critical time intervals are not expected, at minimum demand periods.

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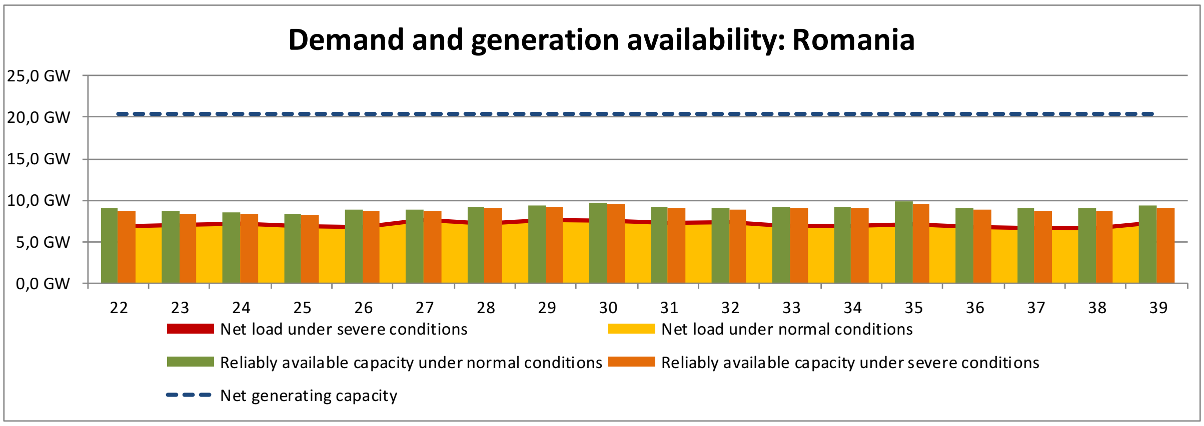
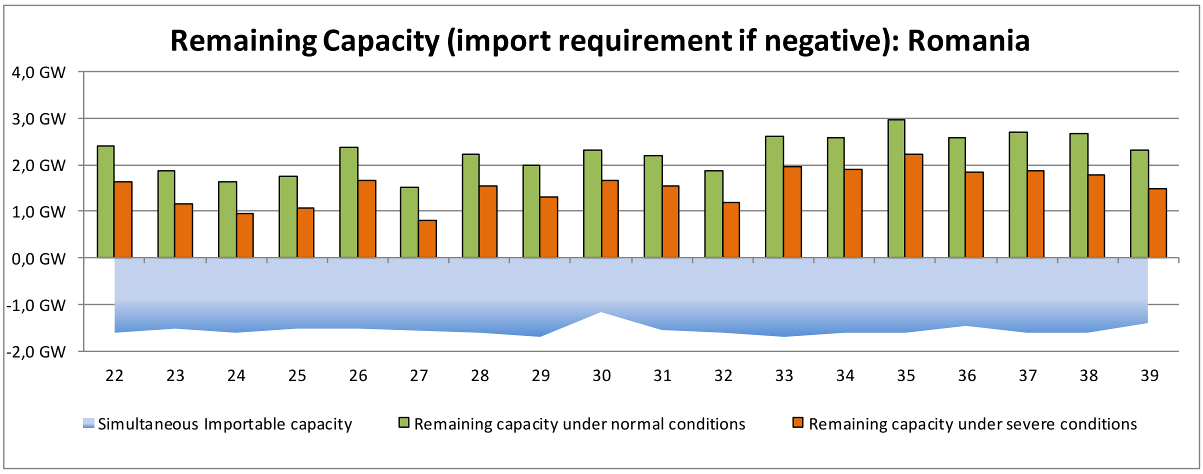
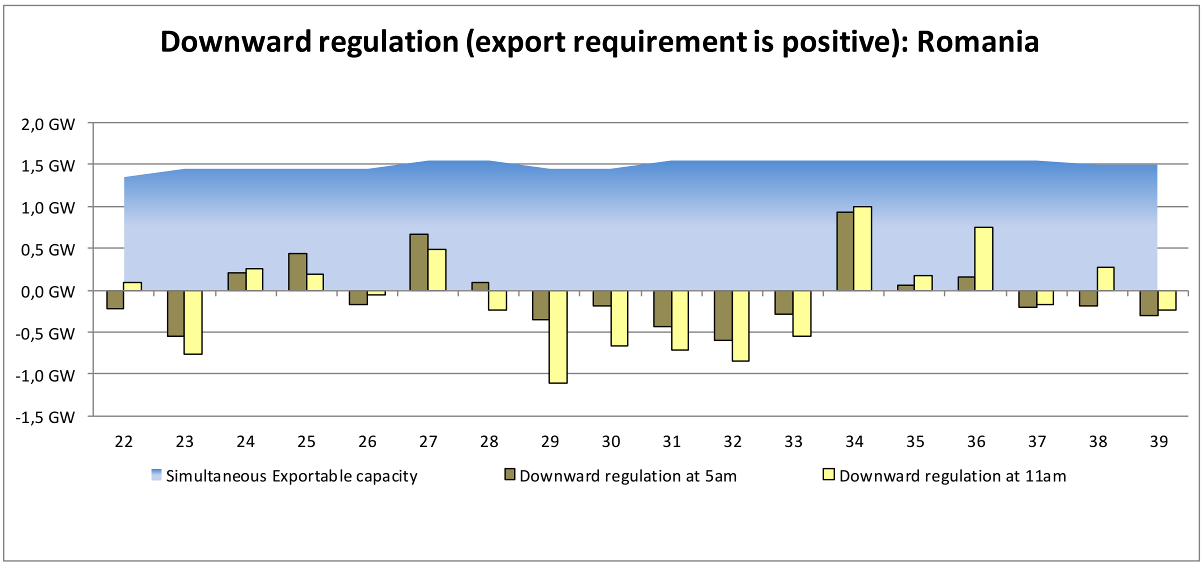

Demand and generation availability: Romania
25,0 GW
20,0 GW
15,0 GW
10,0 GW
5,0 GW
0,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe 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
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Downward regulation (export requirement is positive): Romania
2,0 GW
1,5 GW
1,0 GW
0,5 GW
0,0 GW
-0,5 GW
-1,0 GW
-1,5 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Serbia

For the upcoming summer, problems in covering demand are not expected. Like the last summer, significant export of energy is expected under normal weather conditions.

Slightly higher levels of maintenance are planned for the first half of June, but it will not affect generation-load balance, but will reduce the export of energy. For the rest of the summer, levels of maintenance will be normal.

Under severe weather conditions, i.e. extremely high temperatures and longer dry periods, extremely high peak loads might occur which might result in reduction of the planned energy exports or even in the energy import needs for covering demand.

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

As already mentioned above, critical periods might occur under extremely weather conditions. In that case, if lack of energy occurs, energy needs will be purchased on Serbian market or from neighbouring TSOs through contracts for exchange of emergency energy.

According to harmonized maintenance plan in South-East Europe, some of interconnectors will be unavailable due to maintenance, but it will not significantly affect the ability to import the required 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 exporting at low demand periods and the surplus of energy is compensated by domestic pumping storage. Problems might occur during the short period of the maintenance of all pumping storage units, but can easily overcome by energy export.

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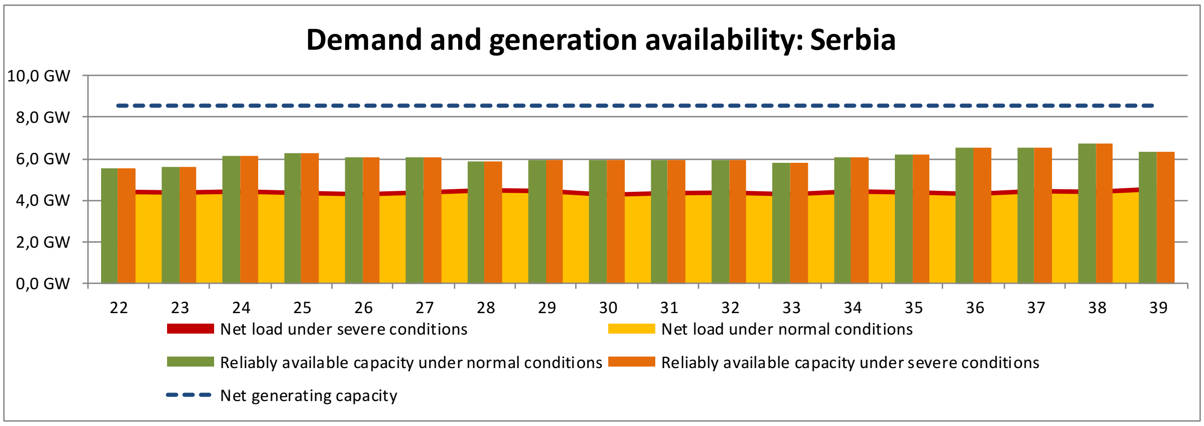
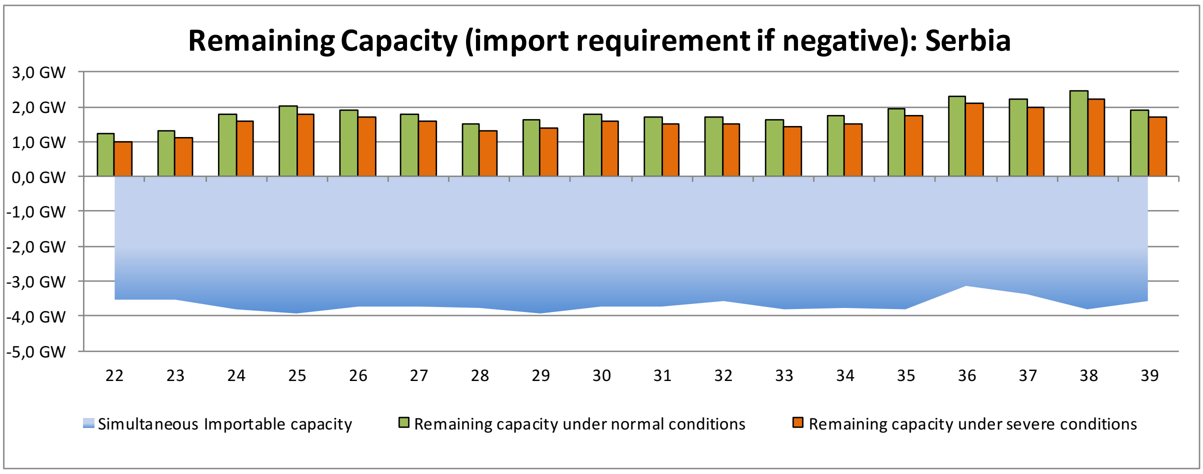
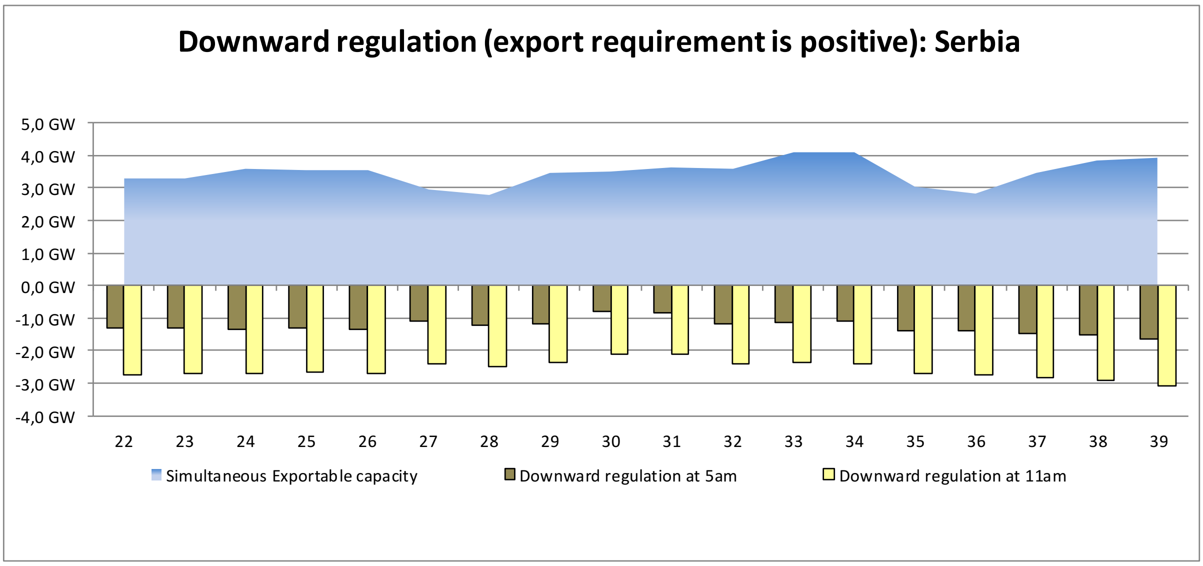

Demand and generation availability: Serbia
10,0 GW
8,0 GW
6,0 GW
4,0 GW
2,0 GW
0,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity


Remaining Capacity (import requirement if negative): Serbia
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
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Downward regulation (export requirement is positive): Serbia
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
-4,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Slovakia

The Slovak TSO expects sufficient generation capacities for the coming summer under normal weather conditions. The generation capacities under severe conditions in the beginning and at the end of summer are insufficient. This is caused by the maintenance of generation units. In June and the last week of October there is a schedule of the maintenance of nuclear units and units of conventional power plants.

The last summer period (2015) was very dry and hot with impact on production of hydro power plants which decreased significantly. In summer 2016 non usable capacities of hydro power plants under normal conditions is expected to be 38% of installed hydro capacities, and 49%, under severe conditions.

The peak demand is expected during the weeks 38 to 39 for both normal and severe conditions. The peak load in summer 2015 was 3 791 MW. The maximum weekly peak load in severe conditions is expected 3 780 MW (same level as in the last summer period).

Load scenarios under normal and severe conditions are based on statistical maximum hourly data including last 10 years. The maximum weekly loads were estimated at the same level as the last year 2015 (we assume the same weather and behaviour of consumers).

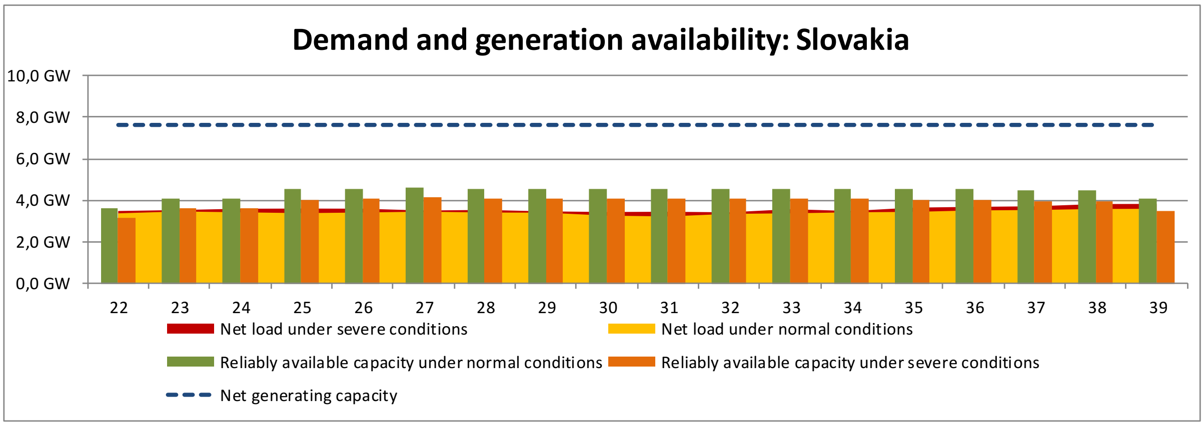
Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

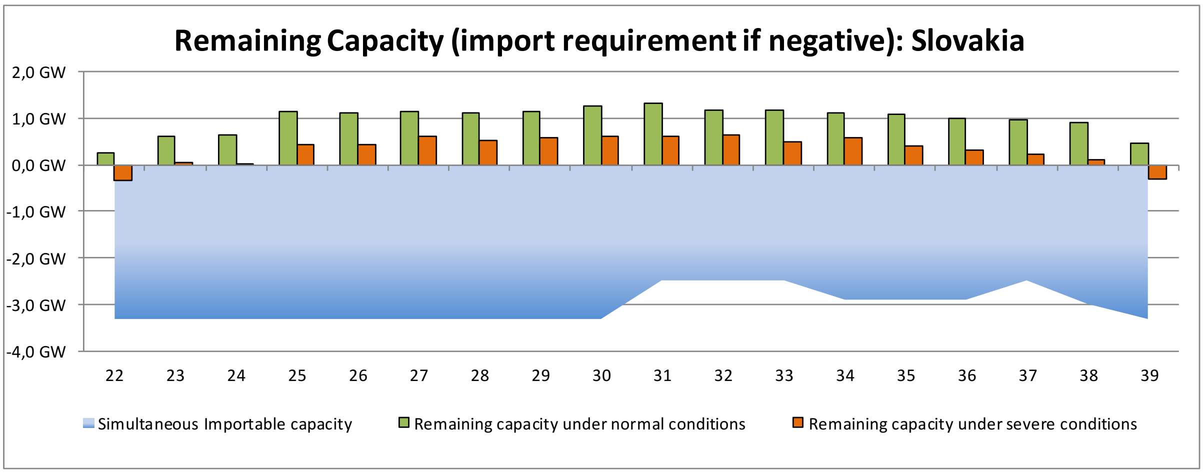
No specific critical periods are expected in Slovakia for the coming summer 2016. In general the interconnections are sufficient for import and export of electricity.

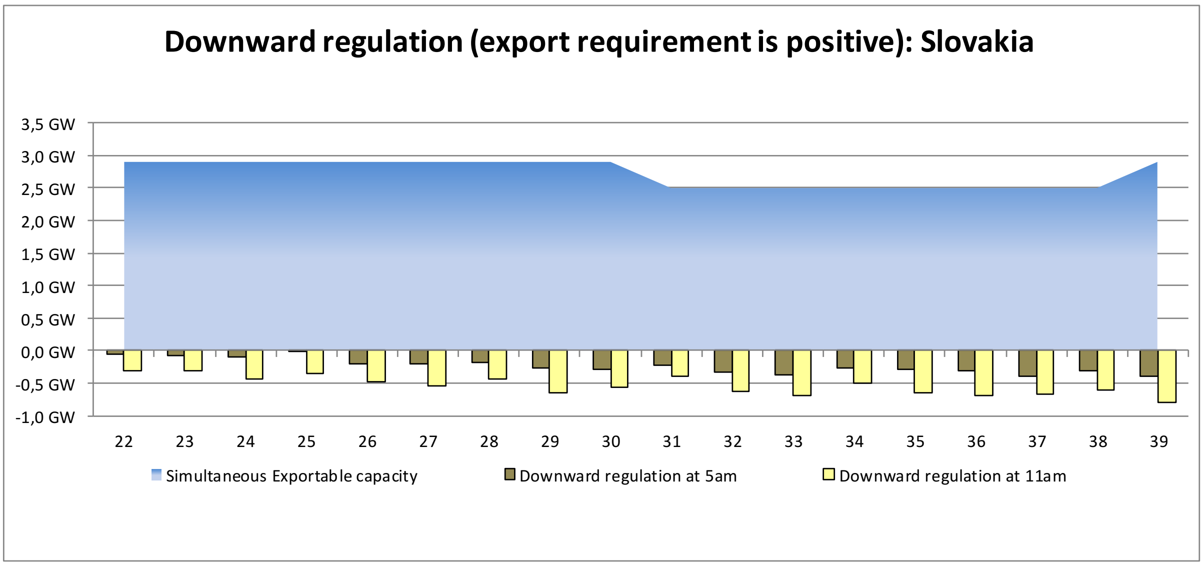
Most critical periods for downward regulating capacity, countermeasures adopted and expected role of interconnectors in managing an excess of inflexible generation

The regulating capacities have the same level as in previous year, no critical periods of these capacities are foreseen in summer 2016.

The inflexible generation in the power system of Slovakia is not so significant and no problems are expected for managing the inflexible generation.







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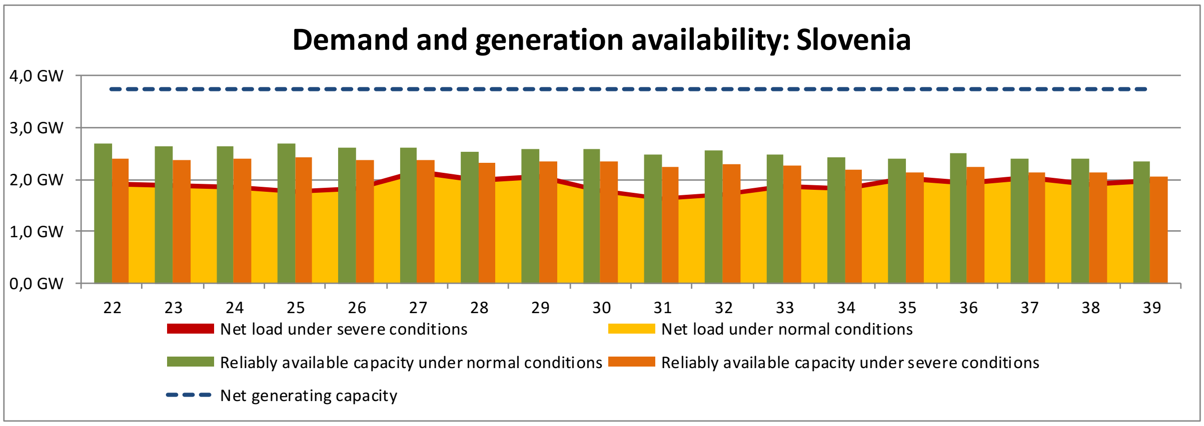
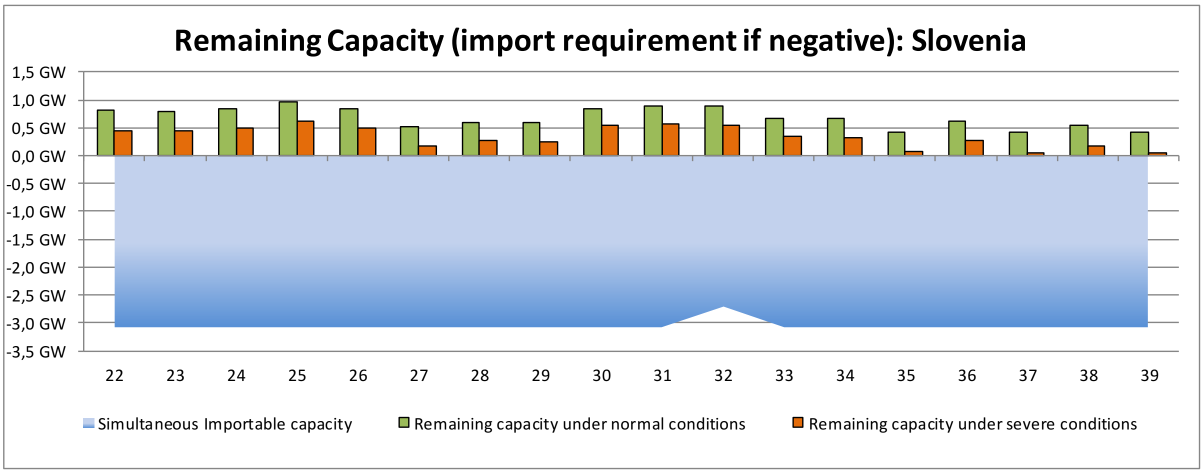
Slovenia

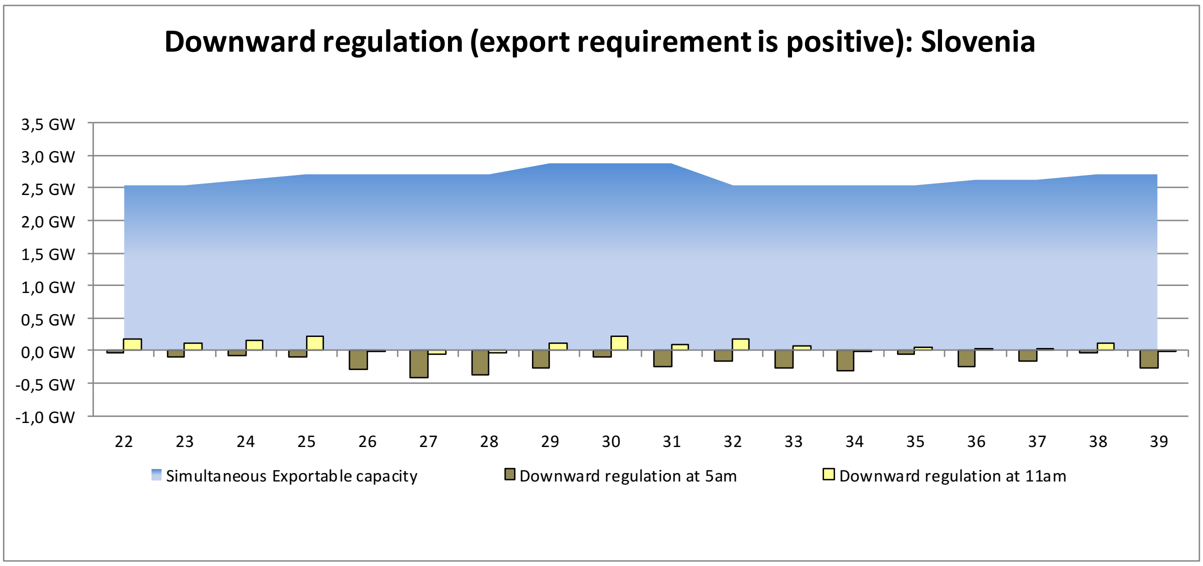
No problems are expected during the summer period. At the beginning of 2016 the unit 5 of the Thermal power plant Sostanj lost its energy licence.

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

In July and August lower hydro levels are expected but without any adequacy issues.


Demand and generation availability: Slovenia
4,0 GW
3,0 GW
2,0 GW
1,0 GW
0,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
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
1,5 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
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Downward regulation (export requirement is 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
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
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 summer. Good generation/demand adequacy can be expected regardless imports from neighbouring countries. If average conditions are considered, remaining capacity will be over 15 GW. In the case of simultaneous extreme peak demand, very low wind generation less than 3% of wind installed capacity, and reduced solar generation, assessed remaining capacity is still over 11 GW.

The demand values increased during 2015, after the significant drop that took place during the last years, due to the economic and financial crisis. The highest demand increase took place during summer, mainly due to the very high temperatures.

It is expected that the total demand in 2016 will increase. Nevertheless, the demand peak values expected for summer with high temperature values and likelihood to be reached of 1%, are the same as the ones expected for the last year.

Hydro reservoirs levels are high at the moment, higher than the historical average values. The most important risk factors for the next summer in the Spanish system could be sensitivity of load to temperature in extreme weather conditions and gas availability to 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 not risk situation concerning generation adequacy, the period with lowest remaining capacity is the month of June due to increased overhauls and likely high temperatures.

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 RES spilling, the most critical periods are the weeks after mid-august, due to lower demand values.

The export capacity of interconnectors is a key factor in order to avoid curtailment of renewable energy, mainly wind power.

The increase of NTC to North Europe due to the new HVDC interconnection with France will be very useful in that sense.

It's also necessary to point out the importance of demand management and energy storage (mainly hydro pump storage plants) in order to properly manage the excess of inflexible power at minimum demand periods. The installed capacity of hydro pump storage plants in Spain has recently increased, and it is currently around 6000 MW.

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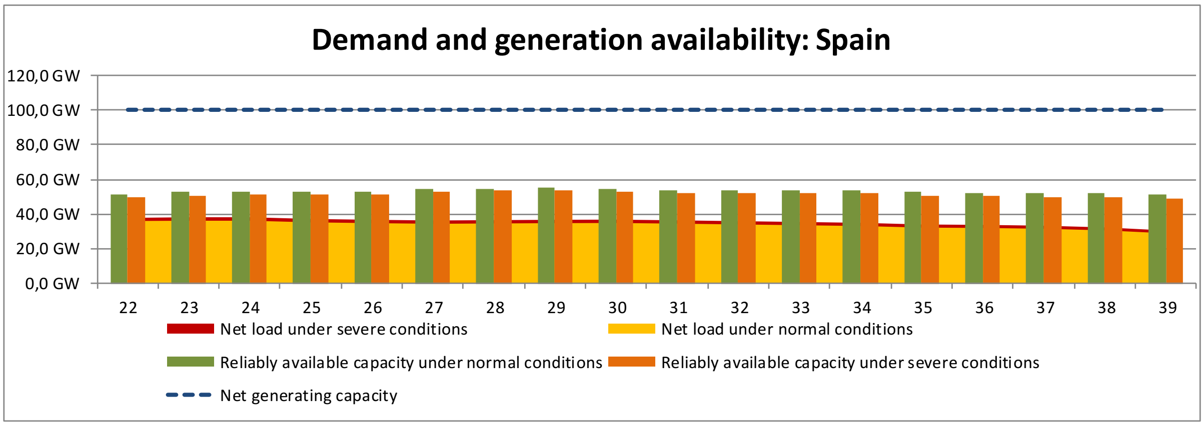

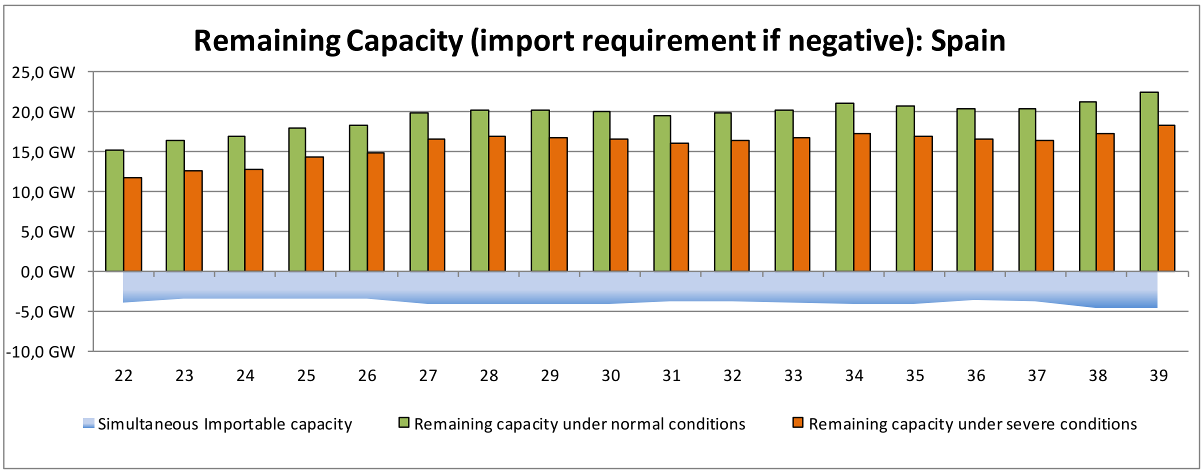

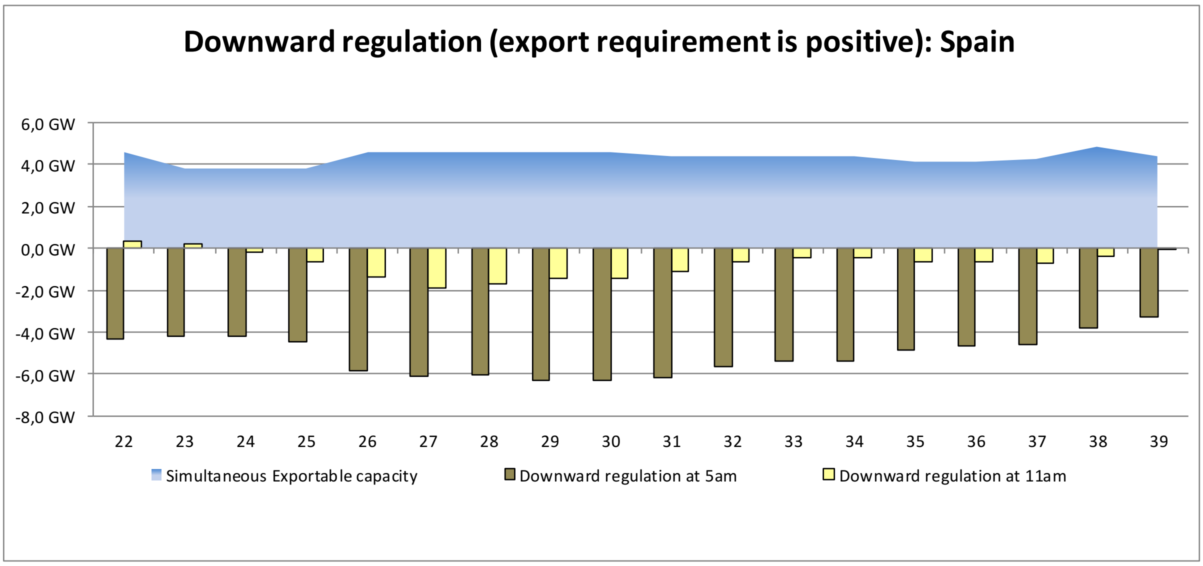

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Sweden

The number of maintenance work is at a normal level this summer. Since maintenance work on transmission lines is avoided if possible during the winter period, most maintenance work is usually done during the summer.

In August, the import/export capacity between Sweden and Norway is considerably reduced; on the interconnection between Sweden and the south of Norway about one third of the normal capacity is available. Maintenance on production is relatively evenly distributed over the period, except in June when the production from nuclear power is reduced to half of the installed capacity. No particular problems are foreseen but the maintenance work requires careful planning.

A new transmission line, the Southwest Link, will increase the capacity between the areas SE3 and SE4 with 600 MW. The link is planned to be available for commercial operation during the end of July.

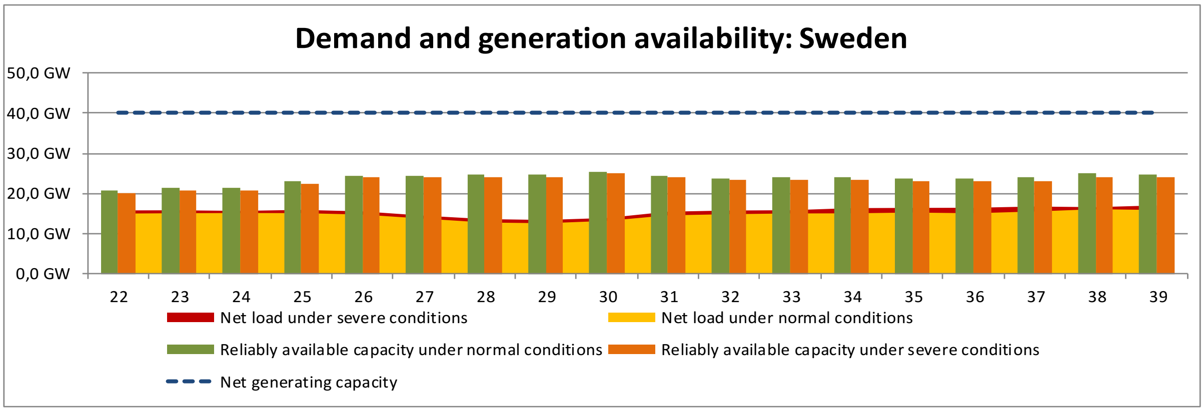
Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

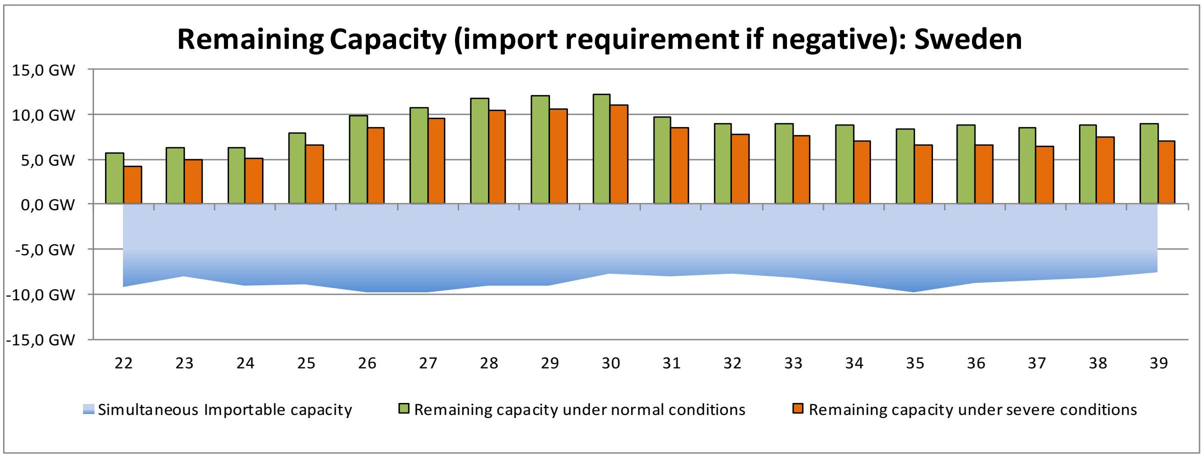
The electricity demand in Sweden is strongly dependent on outdoor temperatures. Due to the climate conditions, the electricity consumption is much lower during the summer and thus there are no expected problems to maintain adequacy. During June when there is a high occurrence of nuclear maintenance, the need for import to the south of Sweden might increase. The interconnectors play an important role to even out prices and for balancing purposes.

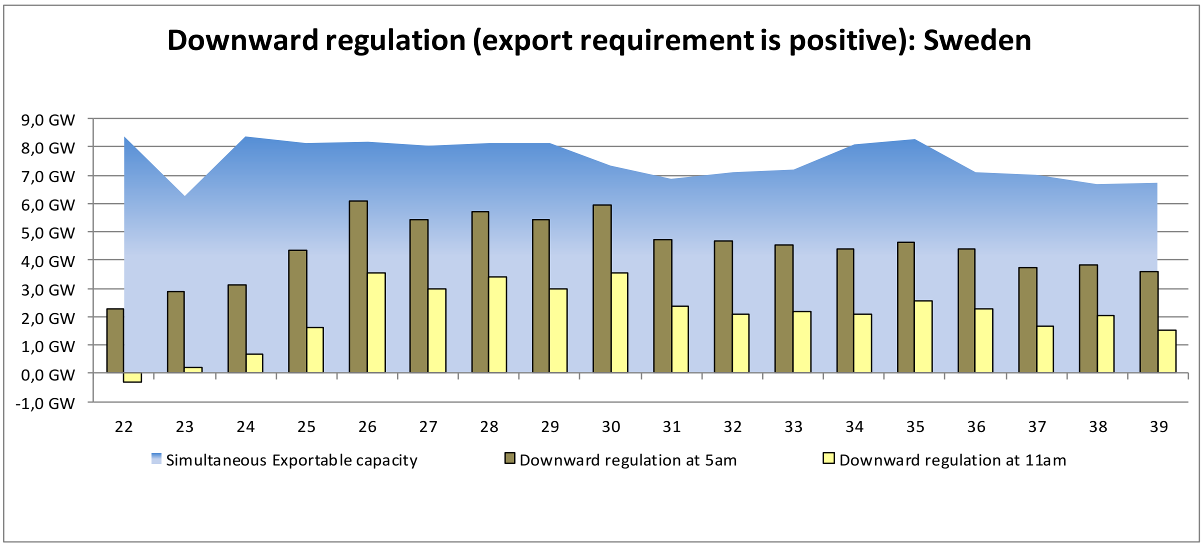
Generally, situations with high voltages are to be expected, especially during nights, due to low load on long transmission lines. This could however be handled by disconnecting parallel lines. This should not cause any problems for neighbouring countries. Furthermore, during spring flood some overloads in the northern 220 kV grid may occur, requiring reallocation of production and/or network sectioning. The hydro reservoir levels are higher than normal in early spring 2016.

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

Thanks to a high share of flexible hydro power, inflexibility can normally be handled. However, the flexibility in the system is decreasing due to an increased share of inflexible generation. At hours when the load is low and a high proportion of the installed wind generation is running, export is likely to be required to handle excess of inflexible generation.







Switzerland

Using this adequacy methodology, no such special problems 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.

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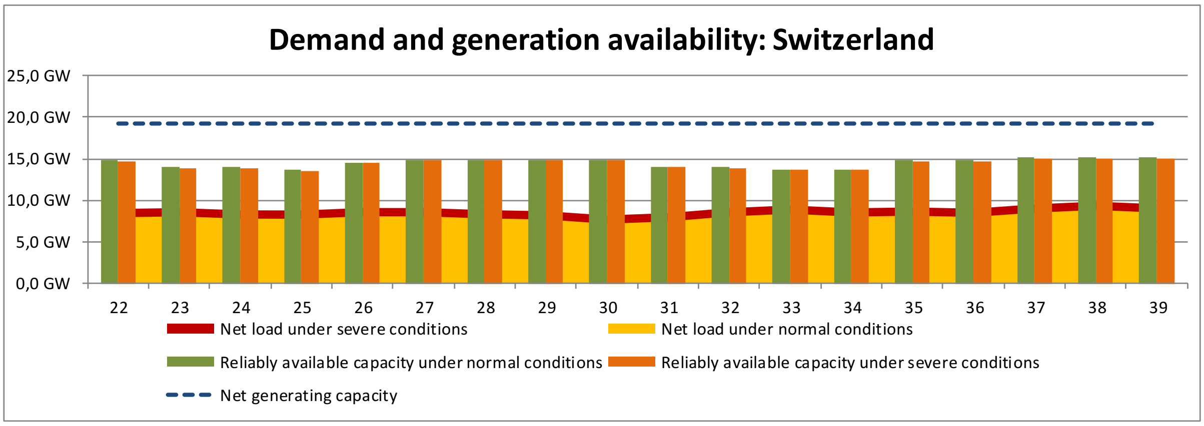
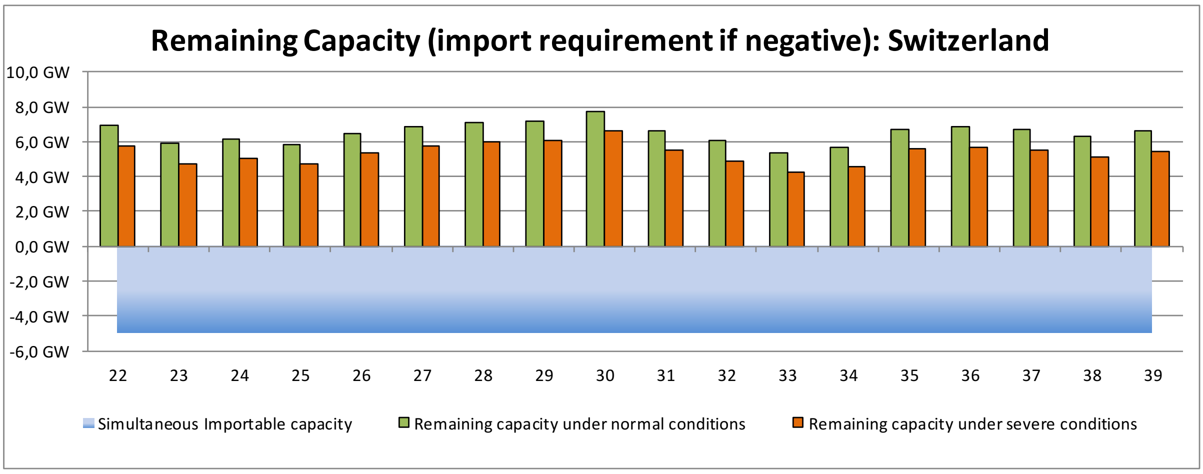
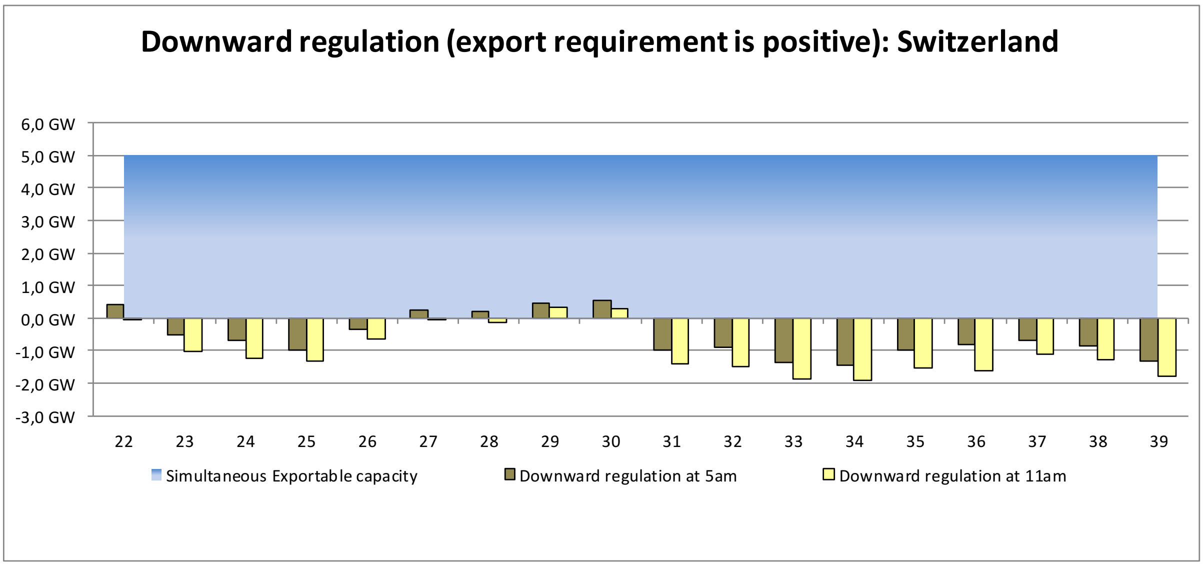

Demand and generation availability: Switzerland
25,0 GW
20,0 GW
15,0 GW
10,0 GW
5,0 GW
0,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity


Remaining Capacity (import requirement if negative): Switzerland
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
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Downward regulation (export requirement is positive): Switzerland
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
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

The Netherlands

For the Netherlands no specific situations in the summer period are expected.

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

High winds specially influences Eastern border due to high wind infeed in the North-East and East of the country. Due to this the Transmission Capacity Available is reduced for System Security reasons. Depending on the expected infeed the Transmission Capacity Available is reduced in relation to.

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 trim unit output.

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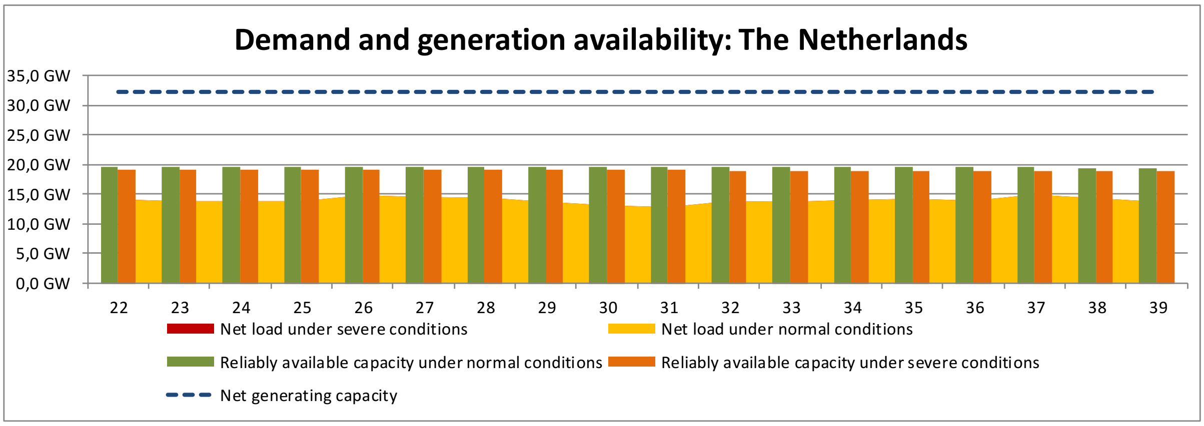
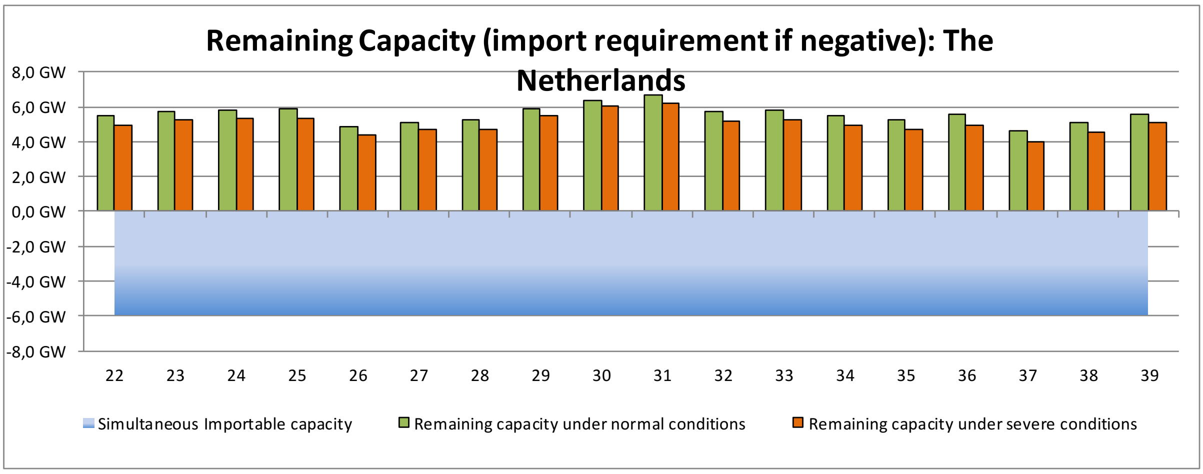
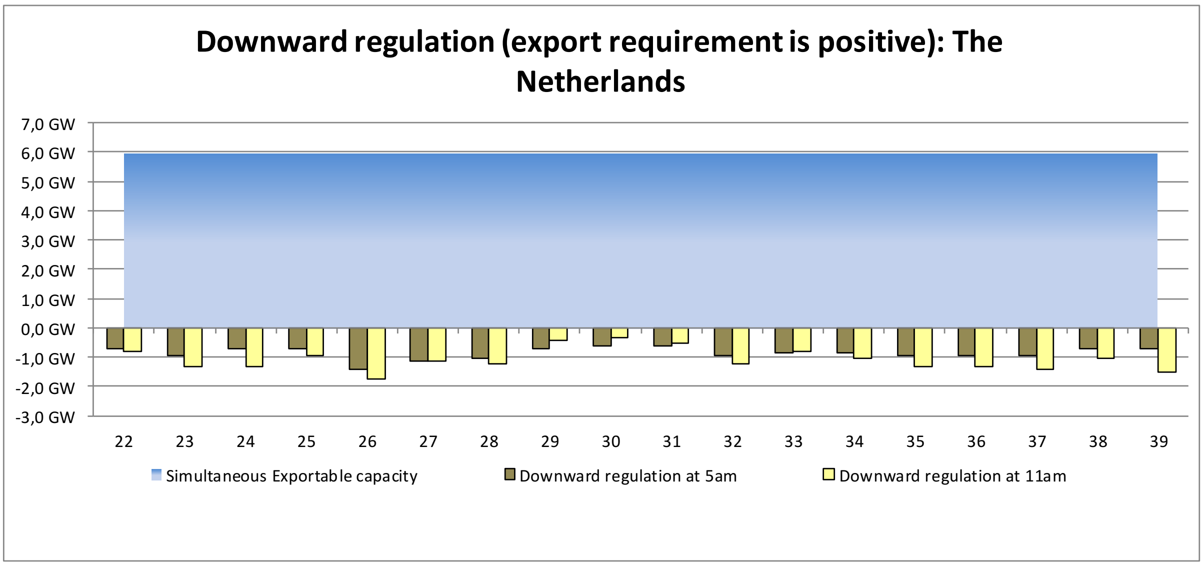

Demand and generation availability: The Netherlands
35,0 GW
30,0 GW
25,0 GW
20,0 GW
15,0 GW
10,0 GW
5,0 GW
0,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available 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
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Downward regulation (export requirement is positive): The Netherlands
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
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Turkey

There is no adequacy problem expected for 2016 summer, even in July and August with the highest seasonal peaks. Hydro levels and gas supplies are sufficient.

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

Critical periods for downward regulating capacity are from mid-March to mid-June. The water income to the run of hydropower reaches its maximum at this time of the year. TEIAS is trying to solve this excess generation problem with reducing power from natural gas powerplants and hydro powerplants with reservoir.

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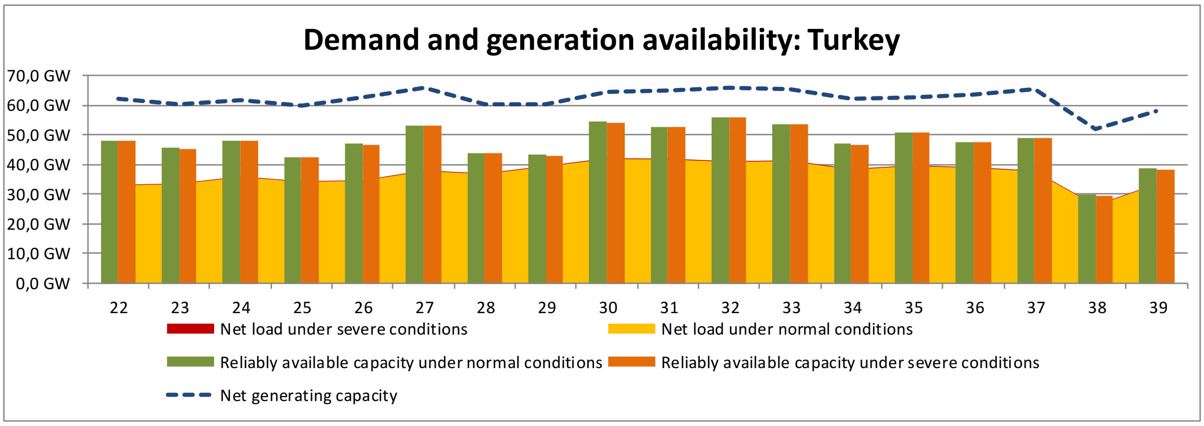
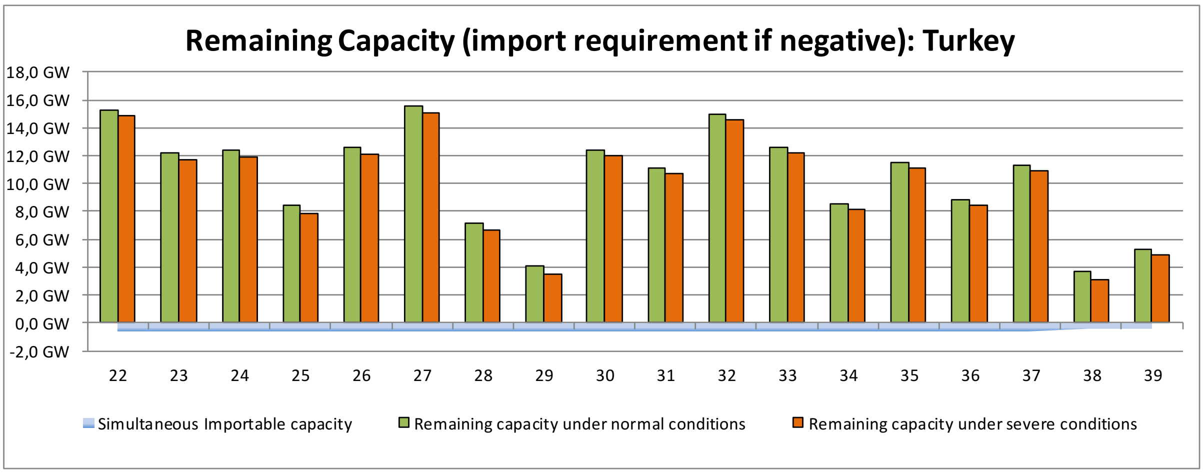
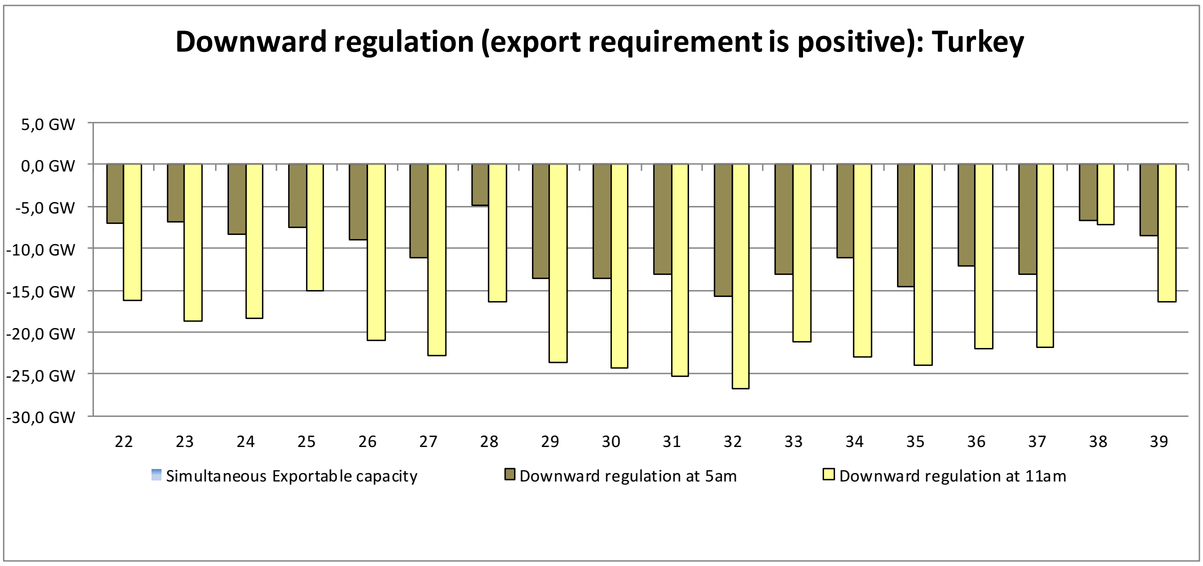
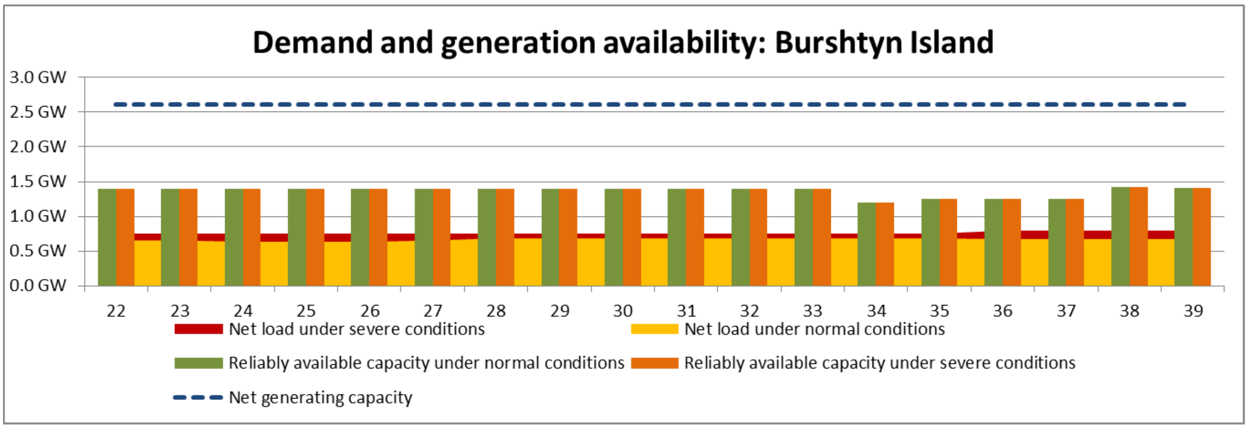

Demand and generation availability: Turkey
70,0 GW
60,0 GW
50,0 GW
40,0 GW
30,0 GW
20,0 GW
10,0 GW
0,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity

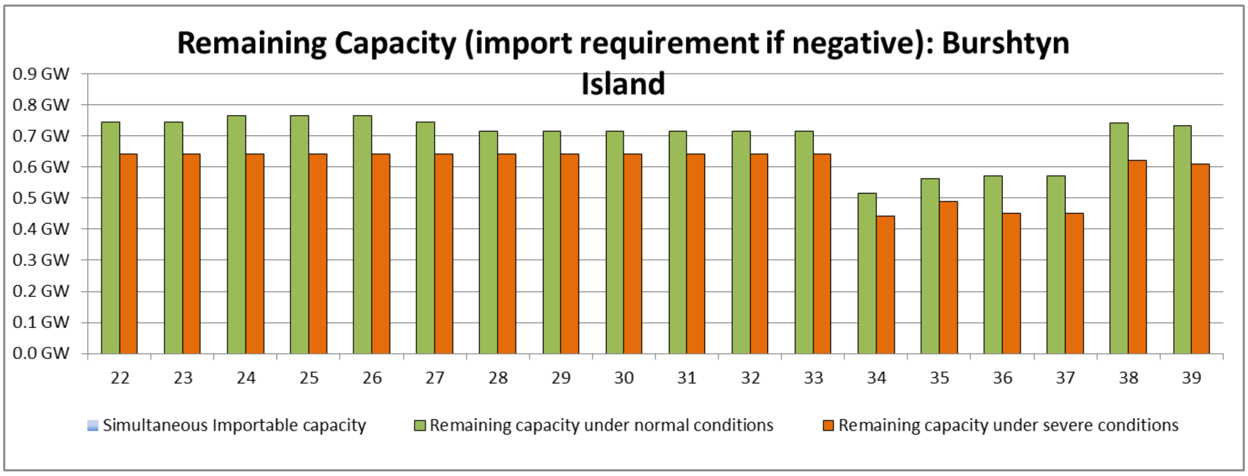

Remaining Capacity (import requirement if negative): Turkey
18,0 GW
16,0 GW
14,0 GW
12,0 GW
10,0 GW
8,0 GW
6,0 GW
4,0 GW
2,0 GW
0,0 GW
-2,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions

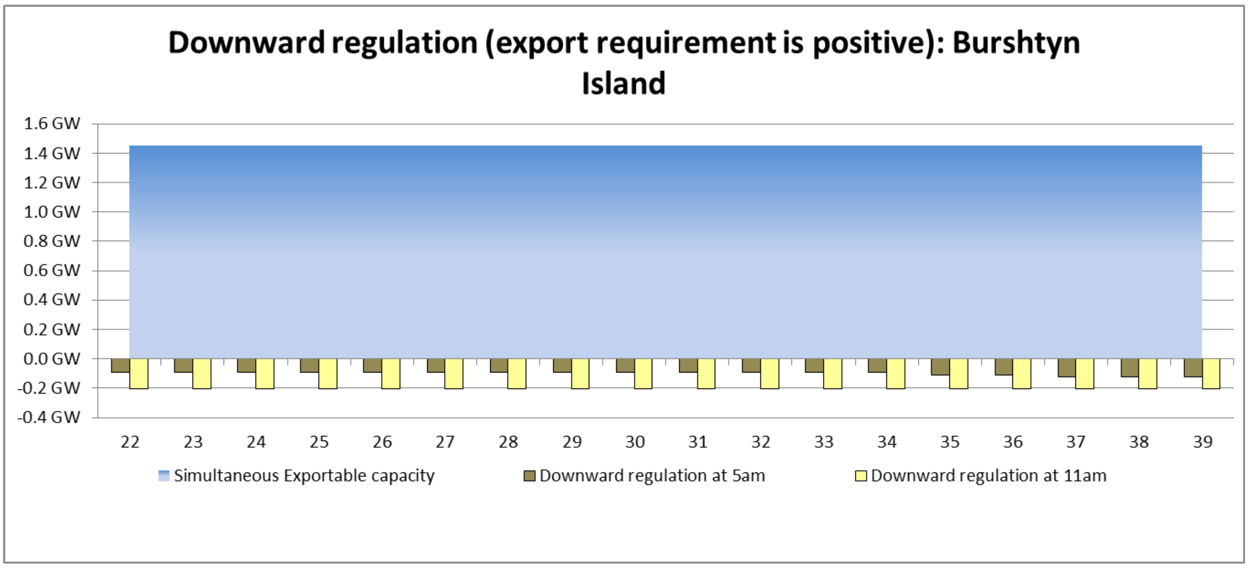

Downward regulation (export requirement is positive): Turkey
5,0 GW
0,0 GW
-5,0 GW
-10,0 GW
-15,0 GW
-20,0 GW
-25,0 GW
-30,0 GW
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Burshtyn Island

No expected adequacy issue during the summer.







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Appendix 2: Individual country comments on the Winter Review 2015/16

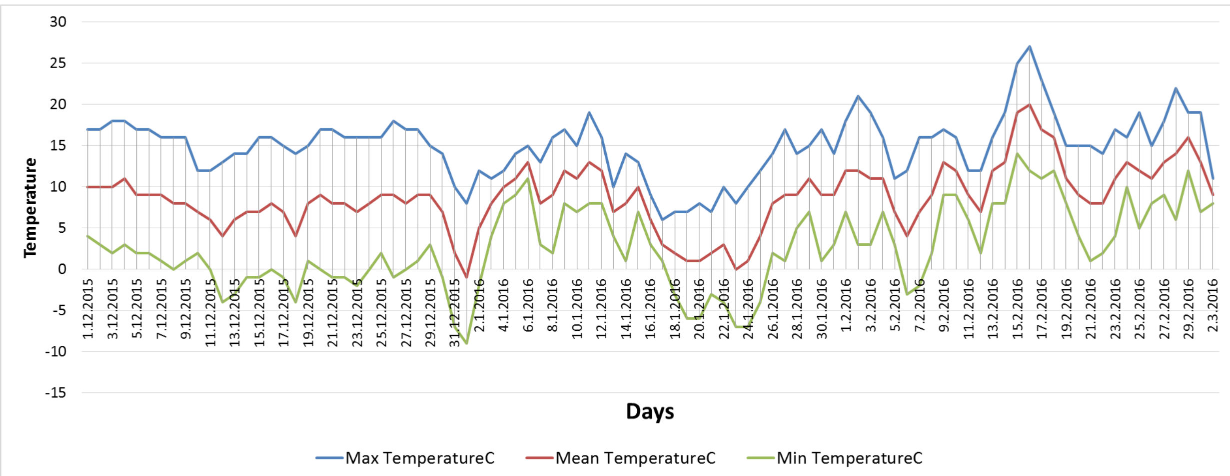
Albania

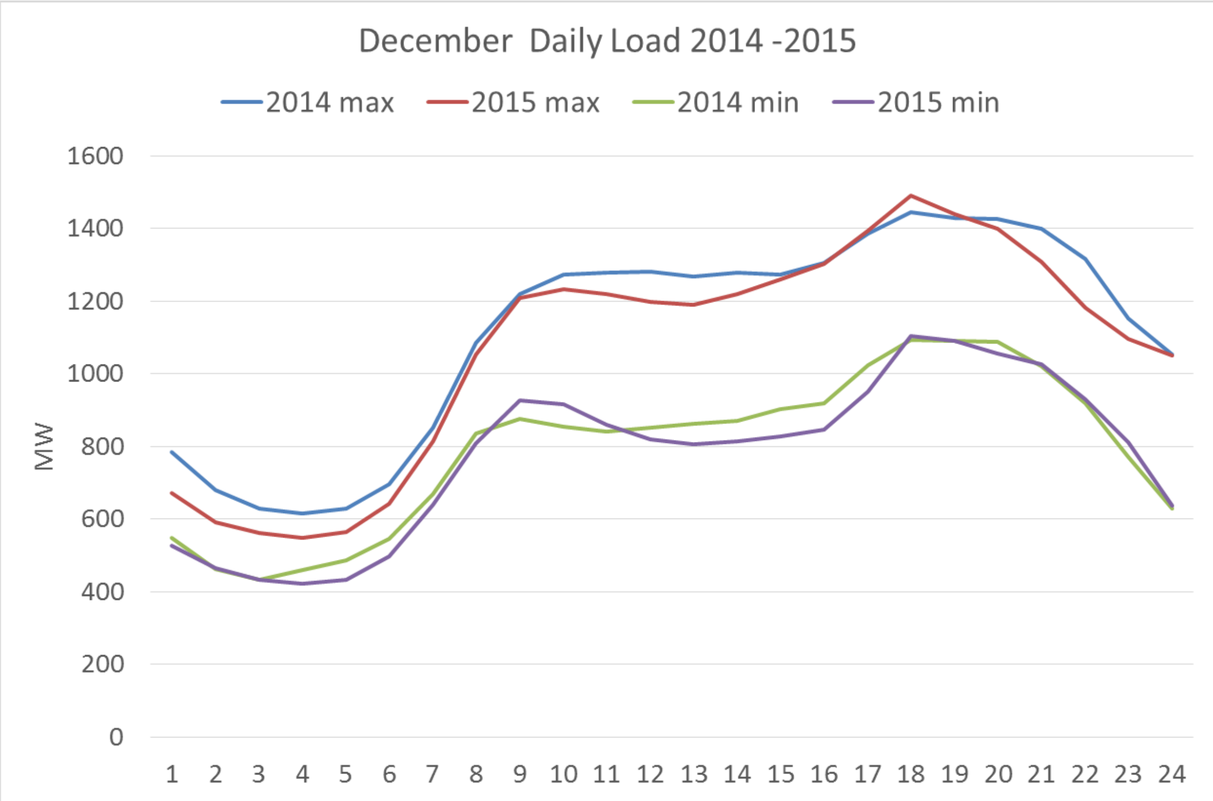
General comments on the 2015/2016 winter conditions

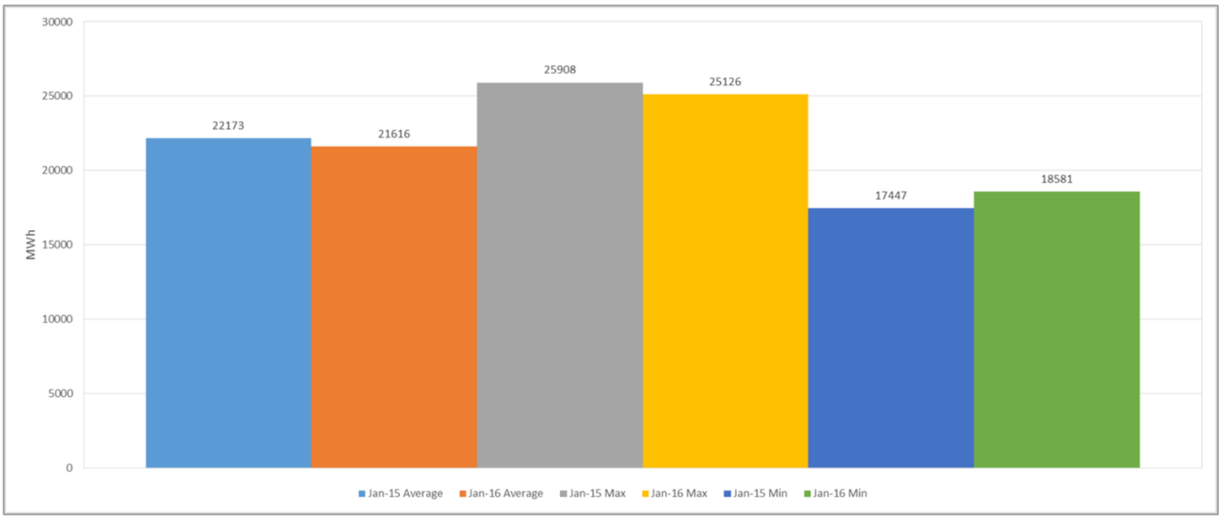
The winter 2015-2016 in Albania was a moderate winter, with temperatures ranging from -9°C min and max of 27°C. The reservoirs levels of the Drin cascade were normal for the season with very few discharges from the reservoirs. The temperatures were normal and the average temperature was slightly above the winter average temperature. The inflows at Drin Cascade were normal for the winter season.

Specific events and unexpected situations that occurred during last winter

The generation situation was normal, as all generation units were in operation with the exception of Unit no.3 in Komani hydro power plant which is under rehabilitation. Regarding the load, it was relatively lower than previous winters. Please see comparison of winter 2015 and winter 2014 in explanatory graphs. Mainly the adequacy was met by firm contracts of import from KESH and OSHEE for December 2015 and January 2016, while in the month of February 2016 KESH also had the possibility to export due to a high level in reservoirs. Currently in Albania there is no side demand response use by the TSO, and there was no load reduction or major disconnections.







Comparison of January 2015-2016 Load Transmission System

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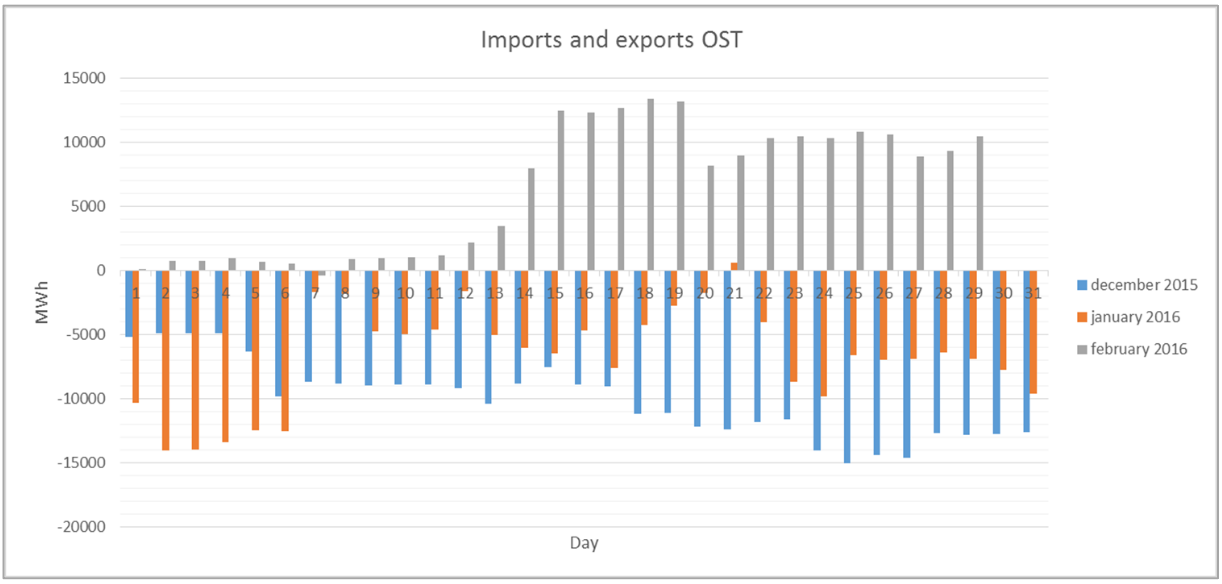

Austria

General comments on the 2015/2016 winter conditions

The temperatures in winter 2015/2016 in Austria were a lot above the average of many years. The bygone winter brought an increased precipitation of 10% above the middle but due to the higher temperatures a reduced snowfall of 50% below the middle.

Specific events and unexpected situations that occurred during last winter

None

Belgium

General comments on the 2015/2016 winter conditions

In order to fulfil the adequacy criteria defined by the electricity law, for the winter period 2015/2016 a strategic reserve capacity of 1.5GW was contracted. This additional capacity can be used in Belgium in case of adequacy issues. The needed volume of strategic reserve was determined for a scenario without the 2 nuclear units Doel 3 and Tihange 2 (closed due to cracks in the reactor vessel). In the beginning of the winter period the return of these nuclear units (1GW each) was confirmed, which reduced the adequacy risk for Belgium drastically. These two elements, in combination with normal winter conditions, did not lead to any adequacy issues for Belgium during winter.

Specific events and unexpected situations that occurred during last winter

None

Bosnia and Herzegovina

General comments on the 2015/2016 winter conditions

During the winter period 2015/2016 there were no significant unusual events in the electric power system of Bosnia and Herzegovina. Maximum load occurred on December 31 at 18:00, and it was 2105MW. Due to hydrological conditions production of hydro power plants was about 50% of the production in Winter 2014/2015, but this shortage was covered by thermal power plants' production.

Specific events and unexpected situations that occurred during last winter

None

Bulgaria

General comments on the 2015/2016 winter conditions

There were no balancing problems during the past winter period.

The monthly consumption in this winter period compared to the previous one is as follows: drop by 2.66% in December, increase by 3.71% in January and decrease by 6.71% in February.

The highest load for the reviewed 2015/2016 winter period was observed on 4th January 2016 – 7105MW. Compared to the peak load of the previous winter (7100 MW on 8th January 2015) there is practically no difference. The average temperature for the examined 2015/2016 (Dec, Jan, Feb) winter period is 4.1°C, approximately 0.5°C higher than the same period in the previous winter (2014/2015 average temperature - 3.6°C).

Water levels in the big reservoirs were quite low because of insufficient inflow during the reviewed winter period which forced a reduction of 38.75% in hydro power plant generation compared to the same previous winter period.

Net exports of energy have dropped by 38.23% compared to the previous winter period.

There were no critical outages in the transmission network.

Specific events and unexpected situations that occurred during last winter

None

Croatia

General comments on the 2015/2016 winter conditions

Winter 2015/2016 in Croatia can be generally characterised as mild. There were not extremely low temperatures or storms that endangered the power system.

Specific events and unexpected situations that occurred during last winter

A lack of precipitation caused the lower generation of Croatian hydro power plants in December 2015. The consumption was not high during the whole winter, but significant amounts of import were needed. The situation became better in February and March 2016 when the hydro plants could be engaged to a large extent.

(The trends of load, generation and cross board exchange are shown in following figures).

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Figure 1. - Hourly load of Croatian power system in winter 2015/2016

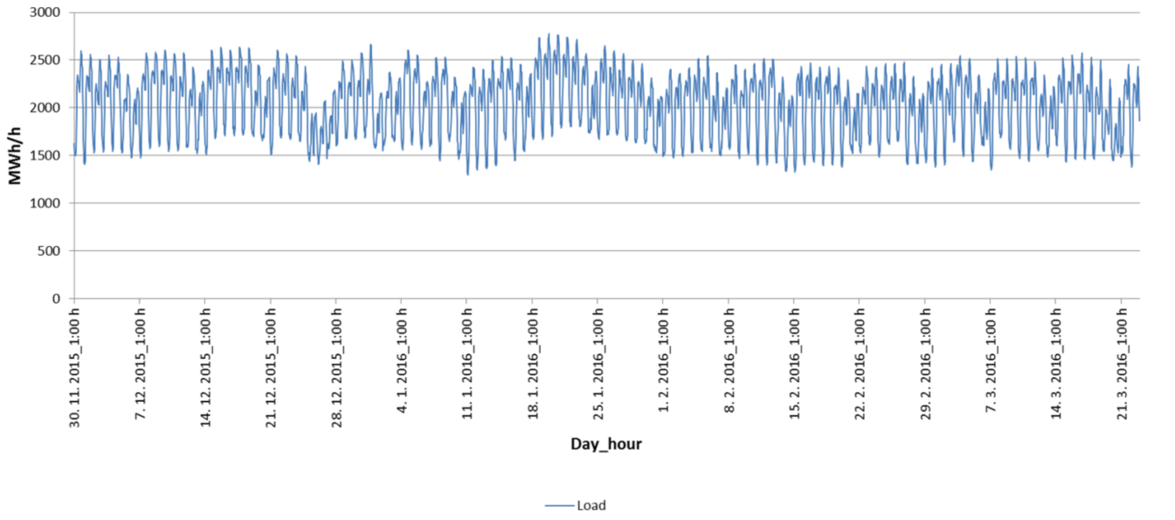
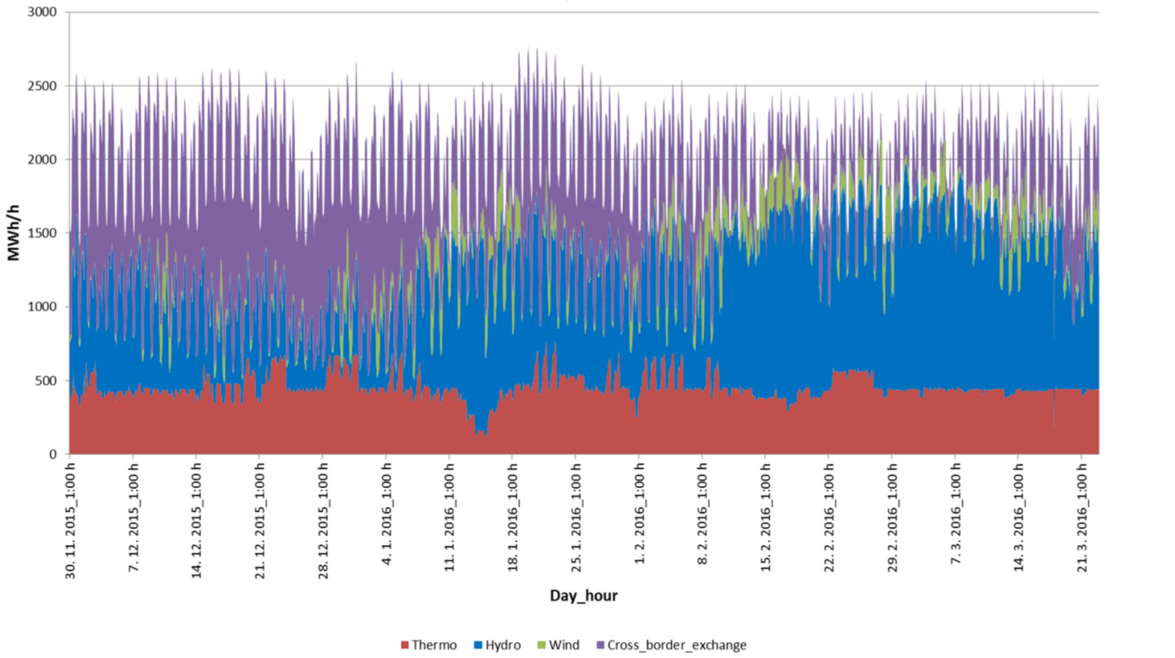


Figure 2. - Hourly generation and cross border exchange of Croatian power system in winter 2015/2016



Cyprus

General comments on the 2015/2016 winter conditions

Load demand recorded was within expected range for normal weather conditions.

Specific events and unexpected situations that occurred during last winter

No stressed periods were observed. No specific events have occurred.

Czech Republic

General comments on the 2015/2016 winter conditions

Last year was the second driest year since 1961. Rainfall was approximately 70% of the average rainfall. Average annual temperature was approximately 11°C which is 0.7°C more than the average. The average winter temperature was 8.5°C. Winter period was very warm and with minimum snowfall.

Specific events and unexpected situations that occurred during last winter

Nuclear power plant Dukovany with 4 x 512 MW installed power had longer and unplanned outage from 19.9.2015 to 31.12.2016 when 2 of 4 units had to be x-raied in the non-nuclear part of the power plant. The reason was poor quality of the achieved x-ray images. Drop in the production at the nuclear power plant was approximately 18% compared to the previous year. Limited generation resulted in reduced export during concerned period.

Denmark

General comments on the 2015/2016 winter conditions

It has been a calm winter without significant operational disturbances. There have been neither snowstorms nor regular storms.

Specific events and unexpected situations that occurred during last winter

The power balance have been good over the winter, with only a few days where the Nordic prices were much above average due to cold weather in Scandinavia. There were no problems with wind generation over the Christmas and New Year holidays which have been seen the past few years.

On the DK1-DE border significant limitations have been experienced, especially in south-bound direction. Indeed, high wind infeed in Germany caused significant limitations on the

DK1-DE border. In addition to this, there has been a lot of countertrading where TenneT DE sells power to Energinet.dk. There have been only a few projects/refurbishments during the winter, mainly due to Energinet.dk spent the winter upgrading the SCADA system.

The SCADA system was put into operation in November and related to this no projects have been allowed to be put into operation to reduce risk. The implementation went well, however there is still some error management and clean-up to be done. The underground cabling project "Vejle Ådalen" has continued over the winter and parts of the project is implemented in the new SCADA system.

Estonia

General comments on the 2015/2016 winter conditions

The winter 2015/2016 was similar to previous year's winter. Most of the time winter was mild only few weeks in January gave Estonia snow and really cold weather. Peak load (1546 MW) occurred on 08.01.16 at 10:20 when the temperature was -14°C, compared with last period winter peak this year's peak was nearly 8% higher. The average temperature of winter (December until 25 of February) was -1.03°C, for comparison in previous winter the temperature was -2.59°C. The coldest period was in January, the average temperature was -7°C and the demand was highest.

Specific events and unexpected situations that occurred during last winter

The generation was sufficient to cover the load, even during peak load and the system was in net export. The usual situation in EE-FI cross-border is import from Finland, but during the coldest weeks (2 and 3) there were hours with full export to Finland (1016 MW) during these hours was also import from Latvia. The power flow between Estonia and Latvia was lower than in previous year, due to long maintenance work in EE-LV cross-border, which limited the transmission capacity.

Finland

General comments on the 2015/2016 winter conditions

In winter 2015 - 2016, December and February were mild but January was colder than in average. All time highest peak load in Finland was recorded in the beginning of January when temperatures sank under -25°C throughout the country. Exceptionally cold temperatures and high load were reached later in January, too. The peak load hours were managed with normal operation and did not cause any adequacy problems.

Specific events and unexpected situations that occurred during last winter

Fingrid's estimate for peak load in severe conditions was reached in winter 2015 - 2016 when new Finnish peak load record, 15.1GW, was made on 7th January. Peak load was covered with import as in previous winters. There were no failures in generation units or transmission lines during peak load hours but most of available generation and interconnector capacity was used. Share of demand side response in balancing power market was remarkable in peak load hours, although occasionally all voluntary balancing bids were used and only contracted reserves were left.

France

General comments on the 2015/2016 winter conditions

In November, the mean temperature was the warmest observed for this month the last 20 years (+0.3°C in comparison with 2014 and +2.2°C compared to normal seasonal levels)

December 2015 had warmer temperatures above 3.9°C to the normal seasonal levels and was the warmest December month since 1900.

As for January 2016, temperatures were 1.1°C higher than in January 2014.

February 2016 temperatures were much higher than the ones in February 2015 (+2.4°C)

No specific climatic event occurred this winter.

Specific events and unexpected situations that occurred during last winter

In November 2015, a reduction of hydraulic power generation in comparison with November 2014 led to a necessary increase in fossil fuel energy, activated to compensate the loss of production. Renewable Energy generation reached a historical peak at 3.5 TWh produced this month with a wind power production of 2.5 TWh (+71% in comparison with November 2014). December 2015, like the previous month, had a decrease in hydraulic power

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generation (-37% compared to December 2014) but no fossil fuel energy was activated because of the low consumption. Renewable Energy generated were more than 3.5 TWh this month. In January 2016, hydraulic power increased by 56% compared to the 2 previous months. Mean wind power is higher than 3300 MW with a historical peak at 3792 MW. This production covered more than 5% of the national consumption. February 2016 had a 30% reduction of fossil fuel energies produced, mainly due to the low consumption. Hydraulic power attained his highest level over the last 12 months with an increase of 8.7% compared to February 2015. A new historical peak of wind power is attained with a monthly mean power of 4119 MW during this month and an instant power of 8604 MW the 20th February at 20 pm.

In comparison with the same month in 2014, in November 2015, consumption increased by 1%. In December 2015, because of warm temperatures, consumption decreased by 9.7%. January 2016 had a decrease of 4.6% of consumption. Even if the month of February 2016 had 29 days, the consumption decreased by 200GWh because of warm temperatures.

From November 2015 to February 2016, 39 new grid elements were implemented, mainly in the South West of France.

Concerning the use of the interconnection capacity, the monthly balance of RTE was in export during all winter. Regarding CWE area, the monthly balance was in import for the first time since the coupling in May 2015 from November 2015 to February 2016, achieving some historical levels of import. Concerning RTE instant export, a new historical instant import level is reached on the 31/01 with an export level at 15.8 GW.

FYR of Macedonia

General comments on the 2015/2016 winter conditions

Generally this winter was with relatively low temperatures.

Specific events and unexpected situations that occurred during last winter

There wasn't any unexpected situation during the winter period.

The operation of power system was secure and reliable over all winter period

Germany

General comments on the 2015/2016 winter conditions

While already November 2015 had been exceptionally warm, December 2015 was the warmest December since the start of data collection in 1881 with far too little precipitation, as reported by the German weather service (Deutscher Wetterdienst, DWD). The average temperature for Germany in this month was about 6.4°C which is 5.6°C warmer than the average of the reference period 1961-1990. The highest value was 18.0°C and the lowest temperature was -8.6°C. January showed plenty rainfall and large regional and temporal differences in temperatures. In average, January has been quite mild with an average temperature of 1.2°C for Germany which is 1.7°C above the reference period 1961-1990. The extreme values were -23.5°C and +18.3°C. In the last quarter of 2015 these conditions came along with long hours of sunshine in southern Germany while being very windy in northern Germany.

Specific events and unexpected situations that occurred during last winter

Due to very low rainfall water levels were low in December in some rivers in southern Germany and caused a limited fuel supply to some coal power plants. As a consequence, TSOs are currently in discussion with relevant operators and the German regulation agency to establish a fuel supply reserve available to TSOs for maintaining system stability in future.

Germany saw an all-time high wind infeed on 08.02.2016 (33.8 GW) and generally a period of a high average wind generation since November. These situations caused a high level of system stress which was mainly solved by

• Extensive measures of re-dispatch (national and international re-dispatch),

• Curtailment of wind as well as

• frequent usage of previously contracted reserve power plants requested by the German TSOs based on Day-Ahead network safety calculations and an enhanced reserve power plant usage planning process.

Furthermore, these situations of high wind infeed led to a high export level and hence high interconnector-utilisation. While the commissioning of a new tie-line between TenneT Germany and 50Hertz in December relieved a major constraint between Northern and Southern Germany, the decommissioning of the nuclear power plant Grafenrheinfeld in June made additional measures necessary to keep up network security. In order to replace the rotating mass of its generator a rotating phase shifter was installed close to Grafenrheinfeld (commissioning in December 2015) to help maintaining system stability.

Great Britain

General comments on the 2015/2016 winter conditions

This has been a very mild, windy and wet winter.

Storms and rainfall caused severe flooding across many northern and western areas in December and January.

There was a brief cold snap in mid-January.

Temperatures were about 4 degrees above long term average.

Specific events and unexpected situations that occurred during last winter

- Generation conditions: the 4th November 2015 was the day with the lowest generation margin. A NISM (Notice of Insufficient Margin was issued) and 40MW of DSBR (Demand Side Balancing Reserve) was used. There was a fault on the French interconnector of 500MW, bringing its capacity down to 1500MW. 3700MW of generation was on planned outage and 6600MW of generation was on breakdown. 1800MW of generation was available under SBR- (Supplemental Balancing Reserve).

- Extreme temperature: mild weather cross the winter.

- Demand: the highest demand was on the 18th January at 17:30GMT at 51.7GW (TSG) which was thought to include the effect of around 1.9GW demand side response. So if unrestricted this figure would be 53.6GW. The restricted forecast was 52.6GW.

- Transmission capacity/infrastructure: 3 generating units (including two reactors at Wylfa) have closed during the winter. A couple of units are back to commercial services from mothballed mode.

- Interconnection capacity/infrastructure: French Interconnector Pole 1 (Bipole 1) had a long-term fault from 05/10~16/11. Pole 2 (Bipole 1) had outage between 05/10~16/10.

- Gas shortages: No issues.

Greece

General comments on the 2015/2016 winter conditions

During last winter there were normal climatic conditions without something extreme and the temperature ranged to normal level for the season.

Specific events and unexpected situations that occurred during last winter

During last winter there were not any specific events on any level.

Though, the plan of connection the Cyclades Islands with the mainland system has started.

Hungary

General comments on the 2015/2016 winter conditions

Because of normal and mild temperature circumstances of winter period there weren't any weeks, when the actual demand was more than 400MW higher than the expected demand.

Generator outages were under 400MW in the whole winter period, excluding only a few days (04~05/12; 22~23/12), when they were over 600MW.

Specific events and unexpected situations that occurred during last winter

There wasn't any extreme temperature circumstance or outage situation.

Iceland

General comments on the 2015/2016 winter conditions

The installed generation capacity provided acceptable system adequacy during the winter period 2015 - 2016.

The total yearly energy fed into the transmission system was 17.8TWh in 2015. The peak load observed this winter was 2223MW. Landsnet has ongoing plans for reinforcing the transmission system for removing bottlenecks. These plans are published in the System Planning report, issued yearly.

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Specific events and unexpected situations that occurred during last winter

None

Ireland

General comments on the 2015/2016 winter conditions

Situation is broadly in line with forecast.

Specific events and unexpected situations that occurred during last winter

None

Italy

General comments on the 2015/2016 winter conditions

The reporting period showed no adequacy problems.

The winter period recorded values of the average temperatures in line with those of the same period in 2015

Specific events and unexpected situations that occurred during last winter

Demand has been similar the same period the last year (increase of about 0.3%).

Even the physical exchange, in the same period of two years, was similar.

At the beginning of the year TERNA implemented a daily process for D-2 cross-border capacity computation, in order to improve the calculation of NTC interconnection capacity.

Latvia

General comments on the 2015/2016 winter conditions

Load sensitivity mostly is dependent on air temperature in winter and air temperature is one of the significant indicators for load deviations from yearly average peak load. During the winter period the peak load has the tendency to increase when air temperature is decreasing below 10°C. During December the load was lower as expected although the average air temperature was lower by 3.4°C. In the end of December and during January the load was higher as expected in normal and severe conditions although air temperature was higher by 4.6°C as in the same time period in previous winter. From February the load is lower all the time as expected in normal and severe conditions. No high floods and rapid molten of snow/ice observed. During the winter the air temperature also influencing NTC values on cross-borders therefore during the winter period the NTC values on EE-LV cross-border were increased. The NTC values from EE to LV and LV to EE almost whole winter period were lower as expected before, bet at the same time the NTC values from LT to LV and LV to LT were higher as expected before.

Specific events and unexpected situations that occurred during last winter

Due to the very high electricity deficit in Latvia and Lithuania the electrical flows were from North to South and the congestions on the border EE-LV in Baltic States have been occurred. The EE-LV border is the weakest point for electricity flows in Baltic States.

Lithuania

General comments on the 2015/2016 winter conditions

The total 2015 winter consumption increased by ~1.5% in comparison with 2014, mainly because average temperature was lower by 1.6°C. The most critical load hours also correlated with extreme temperature periods. Maximum load (1979MW) was reached in the beginning of January (2016.01.08) during the coldest winter week (average -15.4°C).

In general winter balance portfolio consisted of 37% of local generation and 63% of imports from neighbouring countries. The total December generation was higher (31%) in comparison with 2014 basically due to increased (24%) wind generation. The largest part of imported (59%) electricity was from Russia. The new DC interconnection with Poland (LitPol Link) covered 9% of Lithuania import.

Specific events and unexpected situations that occurred during last winter

No unexpected situations had happened in Lithuanian power system during 2015 winter. On 2016 January system imbalance was strongly affected by increased wind generation capacity by 71%.

Luxembourg

General comments on the 2015/2016 winter conditions

No extraordinary situations were recorded.

Specific events and unexpected situations that occurred during last winter

For the generation conditions, there were no important abnormalities. For the temperature, there was no abnormal situation. The coldest period of January was the third week of January.

Malta

General comments on the 2015/2016 winter conditions

This winter has been particularly mild as regards the temperature. In fact the load demand was more similar to low demand months.

Specific events and unexpected situations that occurred during last winter

As regards the demand it was very lower then compared to the forecast due to unusual good and hot weather

Montenegro

General comments on the 2015/2016 winter conditions

Temperatures were above average, generation lowest than expected in period from December till January.

Specific events and unexpected situations that occurred during last winter

The Montenegro's TSO did not face with any mentioned risks.

Northern Ireland

General comments on the 2015/2016 winter conditions

None

Specific events and unexpected situations that occurred during last winter

The Moyle Interconnector, on a prolonged outage since 2012 limiting it to half its capacity, has been restored to full capacity with a project being completed by the asset owner.

Norway

General comments on the 2015/2016 winter conditions

As expected last fall, the hydrological balance this winter has been good in Norway. This has resulted in a surplus of production and low power prices in most of the period, except January as explained below.

Specific events and unexpected situations that occurred during last winter

A new demand record of 24.5GW was observed on 21 January 2016. This was the same as our forecast for a cold winter and occurred at the end of a period with several weeks of cold weather all over the country. The prices increased in most of January, but fell suddenly to the previous level after that day, due to warmer weather.

There have been some weeks with worrying reductions of generating and transmission capacity in the northernmost parts of Norway. This has resulted in periods with disconnection of flexible demand, use of system protection and regulating power. One major hydropower station in southern Norway has a long-lasting failure, but the market has adapted to this failure.

There have been some reductions in the exchange capacity to Sweden and Denmark due to reinforcement projects and internal problems in Norway.

Poland

Power balance situation

As forecasted in Winter Outlook 2015/2016 report no significant problems in balancing the system occurred, as winter was mild in general. The only single stressed period with tight power balance took place in the first week of January 2016, when low temperature (down to

-15°C; country average) and low level of Vistula river (dry summer and its continuation in Autumn) caused partial freeze of this river. As the result higher level of non-usable capacity was registered in the biggest power plant located by this river (water used for cooling).

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 result of development of subsidized (thus attractive from the cross-border trading point of view) renewable energy sources in the northern part of Continental Europe (CE). PSE takes position, that currently there is no proper coordination of capacity calculation and allocation process in Continental East Europe (CEE) now, therefore very often the unscheduled flows from the northern part of CE to the south resulting from above-mentioned transactions cause a violation of the N-1 criteria. TSOs from CEE, in cooperation with TSOs from Continental West Europe (CWE) region, are currently working on implementation the Flow-Base Approach, which should allow for correct coordination of capacity calculation and allocation in whole CE.

During the winter 2015/2016 (from December to March) these flows were also limiting import capacity towards Poland, which could not be offered to the market on synchronous profile (borders with DE+CZ+SK). PSE was not able to offer import capacity in yearly, monthly or day-ahead horizon because commercial imports to Poland increase physical flows on the PL/DE border, which is already congested by unscheduled power flows. Only very limited import capacity was offered to the market during intraday auctions (what depended on the current level of unscheduled flows from Germany through Poland).

Unscheduled flows often 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, realized according to 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-costly remedial action.
2. Bilateral cross-border re-dispatch (CBR) between PSE and 50Hertz, realized according to agreement signed in May 2008 and updated in 2014. This measure consists of increased generation in Poland and decreased generation of 50Hertz.

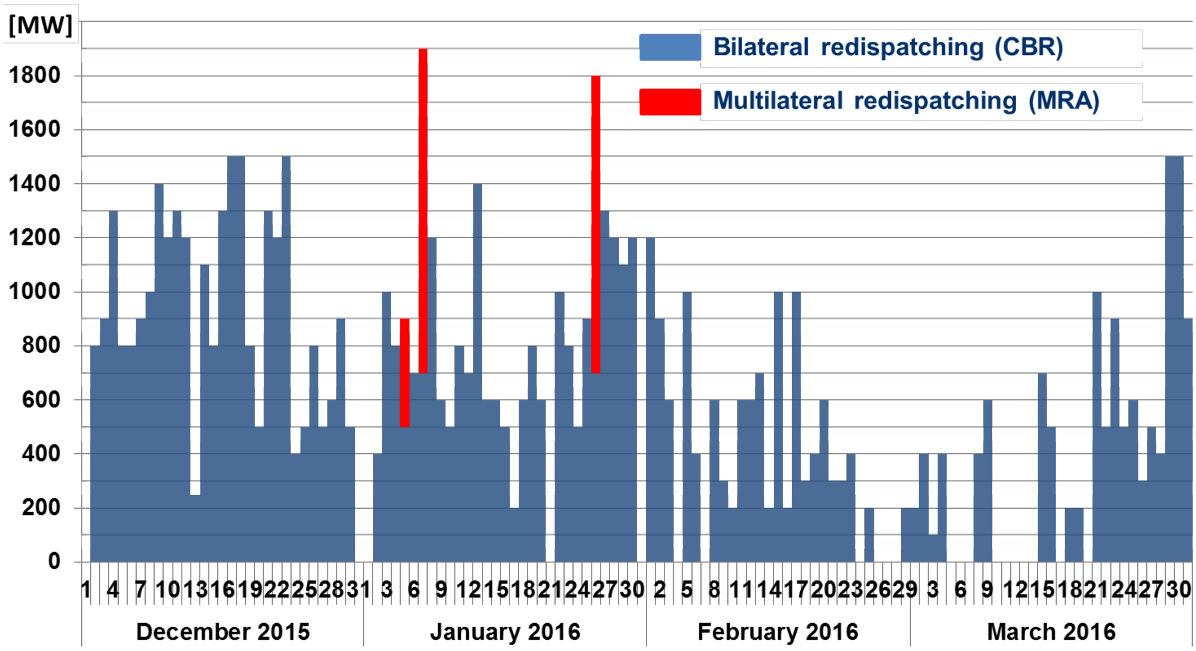
This measure relies on available generation in Poland (the most effective is using power plants located next to the PL-DE border) and the possibility to decrease generation in Germany and can also be limited by physical flows between PSE and CEPS (in order not to create more congestion there). It is 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 ever 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' control areas and the possibility to decrease generation in Germany. It is a costly remedial action, with the highest costs of all measures.

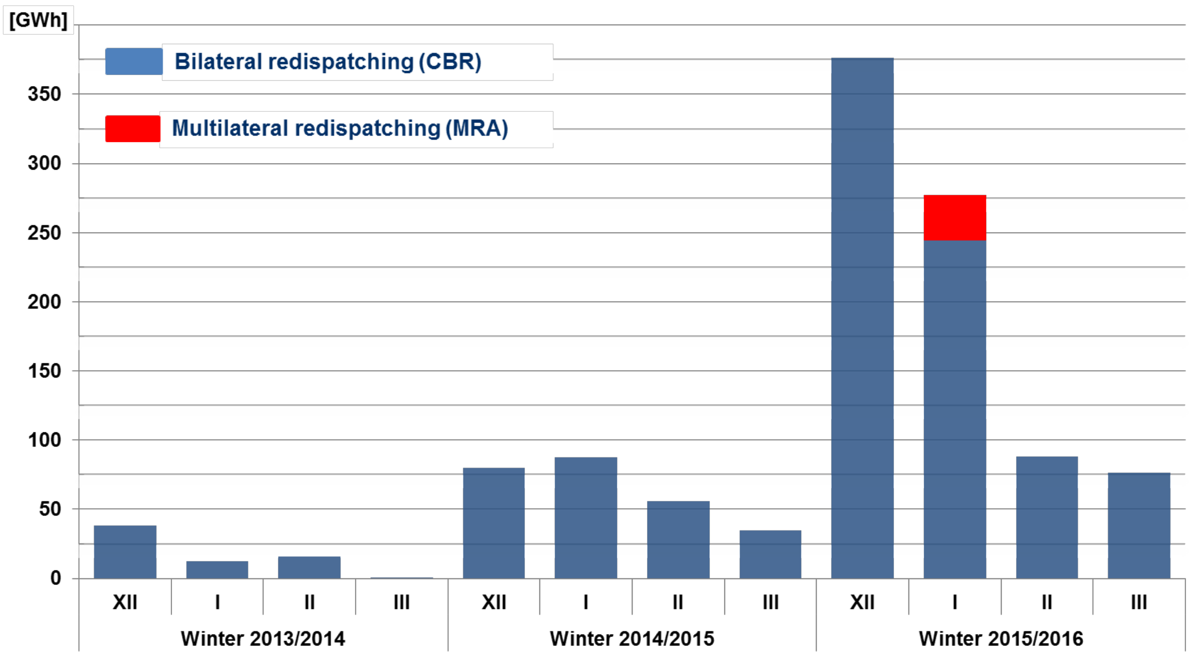
During the winter 2015/2016, an excessive level of unscheduled flows caused the need to use remedial actions to fulfil N-1 criteria almost every day. Below are presented the number of days when CBR and/or MRA had to be activated (DC loop flow was usually not possible in daytime hours due to the full usage of PL/SE HVDC link in a southbound direction in problematic hours):

- 29 days from out of 31 in December (94%)
- 28 days out of 31 in January (90%)
- 23 days out of 29 in February (79%)
- 21 days out of 31 in March (68%)

The figure below presents the maximum power of CBR+MRA in each winter day, which must have been activated to keep N-1 criteria and interconnected system in secure state:



The result of such frequent usage (and at such high level) for CBR 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). There was more than 330% increase of mentioned volume, when comparing winter 2015/2016 to winter 2014/2015:



Favourable weather conditions, as in most cases there was enough power in Polish power system for bilateral cross-border re-dispatch to decrease volume of unscheduled flows, allowed PSE together with other TSOs to successfully manage fulfilling N-1 criteria and interconnected system was operated safely. Nevertheless summer 2015 showed that unfavourable weather conditions may occur and in situation of high unscheduled flows, the risk of danger the interconnected system of Continental Europe caused by not fulfilling N-1 criteria is possible as no sufficient capacity may be available for re-dispatch measures then.

Due to fact, that the ultimate solution concerning unscheduled flows, means structural market improvement (i.e. flow based mechanism for coordination of capacity calculation in relevant region with properly configured bidding zones), will not be implemented before 2018 and having regards to possible generation shortage during severe conditions, PSE has asked TSOs in the TSO Security Cooperation (TSC) area to take an interim 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. Unfortunately, the progress on the above mentioned interim actions has been too to slow and looks to be insufficient for summer 2016. Regardless of these actions within TSC, PSE in cooperation with 50Hertz analysed other bilateral measures possible for timely application, which could reduce negative impact of unscheduled flows on interconnected system security.

Other information

New connection between Poland and Lithuania was put into operation in December 2015. Till then there was no connection between Polish and Lithuanian systems. The connection is realised by AC 400kV double circuit line with back-to-back in Alytus substation (Lithuania) as Baltic counties are operating synchronously with IPS/UPS. Nominal capacity of the link is 500 MW. The new connection enabled commercial energy exchanges between Poland and Lithuania and gave possibility to import energy in case of tight power balance situations in Poland – i.e. improved security of supply.

Portugal

General comments on the 2015/2016 winter conditions

This winter season was remarkably mild with temperatures in some periods significantly above the average, which had a negative impact on demand. The winter peak load occurred in February (8169MW) and stood 300MW below the previous year values. On the other hand, weather conditions were very favourable to hydro and wind generation that registered productibility levels of 52% and 24% above the average, respectively.

During the season, the Portuguese system was highly exporter. Exports represented about a quarter of the national demand in 2016, which represents a record.

With some strongly exporting periods, the generation peak has disconnected from demand peak, so this year the Portuguese system has registered a new maximum of 11516 MW, more 600MW than the previous record set in February 2015.

Specific events and unexpected situations that occurred during last winter

None

Romania

General comments on the 2015/2016 winter conditions

In December 2015, the average air temperature was higher than normal one across the country. Maximum total precipitation amounts were lower than normal in all regions. In January 2016, the air temperature had values lower than normal ones in the South of the country, and for the rest of the country the air temperature was within normal limits. In the South of the country heavy snowfall were for several days followed by frosty and windy days. In February 2016, the average air temperature was higher than normal one across the country. As a conclusion, no risk occurred in terms of adequacy during the weather conditions during the last winter 2015-2016.

Specific events and unexpected situations that occurred during last winter

During the winter 2015-2016 certain unplanned disconnections of internal lines occurred, but without any influences on interconnection capacities. The interconnectors were used to facilitate the exchange schedule (export/import) according to the allocated NTC values on the market. Also, there were not any situations as gas shortage that could have affect the power system adequacy during the winter 2015-2016.

Serbia

General comments on the 2015/2016 winter conditions

In general, last winter was passed without any significant problems.

The winter was very mild with temperatures above the average.

Therefore, during the whole winter, a significant amount of energy was exported due to the much lower loads than expected.

Specific events and unexpected situations that occurred during last winter

No adequacy problems and risks mentioned in the Winter Outlook were occurred.

Slovakia

General comments on the 2015/2016 winter conditions

During the winter period 2015/2016 there were no significant unusual events in the power system of Slovakia. The consumption of electricity increased, whilst the production decreased, that is why the import share in the consumption increased. Cross-border physical flows were high in some weeks and the peak load come back to normal level.

The weather conditions of winter 2015/2016 were normal. The overall average temperature (1.70°C) during winter months from December 2015 to February 2016 was almost the same as in the previous winter (1.77°C). Following table shows average monthly temperatures of previous two winters.

Table 1 – average monthly winter temperatures

Month / Year	2014/2015	2015/2016
December	2.9°C	2.4°C
January	1.3 °C	-2.0°C
February	1.1°C	4.7°C

The weather (temperature) is just one of influence on electricity consumption, another is economy, structure of industry etc. Following figures are preliminary results of winter 2015/2016 in comparison to winter 2014/2015 (December to February).

There was an increase of total electricity consumption (101.1%), conversely total electricity production decreased (97.9%). The highest increase of consumption was in January

(103.4%) while the electricity production in January decreased (93.7%), therefore the import of electricity in January shared 12.6% of consumption (the highest share of this winter). Decrease of production in January was mainly influenced by low hydro power plants production (65.0% in comparison to January 2015) and decommissioning of two thermal units in the beginning of the year (220MW).

There was an import of electricity into the power system of Slovakia during all winter months. In winter 2015/2016 the total import of electricity increased to 612GWh (in winter 2014/2015 it was 332GWh). The share of imported electricity in the consumption increased to 7.8% (compare with 4.3% in winter 2014/2015).

In the winter outlook report the winter peak load prediction was 4350MW. The real winter peak load was 4319MW (Tuesday, 19th January 2016, 9:00), which is normal figure, whilst in the winter 2014/2015 it was only 4126MW.

In January 2016 high physical flows via cross-border tie-lines of Slovakia were measured. Therefore changes of normal switching state of boundary substations were performed several times. High cross-border flows also jeopardized fulfilment of N-1 criterion. Accordingly neighbouring TSOs were informed via real-time awareness and alarming system about endangered states of the power system of Slovakia.

Specific events and unexpected situations that occurred during last winter

None

Slovenia

General comments on the 2015/2016 winter conditions

In average, winter temperatures in Slovenia were higher than normally but there were also less sunny days. The amount of precipitation was lower in December and substantially higher in February.

Specific events and unexpected situations that occurred during last winter

Except from substantially higher physical flows from Croatia due to high hydro generation on Balcan in the second half of February, there were no special events during winter. The peak demand occurred in the first half of December. Demand was also high in the second half of

January, as forecasted in the Winter Outlook. However, Slovenia did not meet any adequacy issues during the past winter.

Spain

General comments on the 2015/2016 winter conditions

In general, the temperatures are being similar to average values during winter. Wind production is also similar to average. Water inflows are slightly lower than 2014.

Month by month:

December 2015:

Temperatures have been higher than average (around 2°C). Water inflows in reservoirs were lower than average. Wind production was lower than in December 2014 (decreasing of 25%).

January 2016:

Average temperatures have been higher than average (around 2.5°C). Water inflows in reservoirs were higher than the average level (40% higher). The wind production was higher than in January 2015 (increase of 14%).

February 2016: Temperatures have been higher than average (around 1°C). Water inflows in reservoirs were similar to average. The wind production was slightly higher than in February 2015 (increase of 2.4%)

Specific events and unexpected situations that occurred during last winter

Not significant operational risks had been foreseen. System operation and system adequacy functioned without any larger problems during 2015-16 winter.

Sweden

General comments on the 2015/2016 winter conditions

January was colder than normal in most parts of Sweden, during the first week the lowest temperature in 15 years was measured. In general however, the winter was warmer than normal due to December and February being mild.

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Specific events and unexpected situations that occurred during last winter

Low temperatures and high consumption resulted in a strained power balance in January and some planned maintenance work was rescheduled for that reason. At the Swedish peak load hour, the consumption was close to 27000 MW, which is in line with the expected peak demand on a cold winter day occurring every tenth winter. In order to secure a sufficient margin for the power balance, the standby time was changed a few times for the production part of the Swedish peak load reserve. On some of these occasions, a part of the peak load reserve was set on minimum generation to be able to ramp up immediately but no further activation was needed.

Switzerland

General comments on the 2015/2016 winter conditions

December 2015 - the warmest since the introduction of measurements in 1864 (3.2°C higher than the norm in average) - was marked by a spell of good weather. Moreover, December was very dry.

January 2016 was marked by a temperature above the average (1.8°C higher than the norm). In the north of the Alps, there were high precipitations, but in the south of the Alps, the precipitations were below average).

February 2016 also was marked by temperatures above the norm (2.3°C) and by high precipitations.

Specific events and unexpected situations that occurred during last winter

During the last months of 2015, a tense situation was experienced:

» Outage of nuclear power plants Beznau 1 and 2 (720MW): Beznau 1 offline until July 2016; Beznau 2 (365MW) went back on grid on 23/24 December 2015 after a 120 day overhaul.

» Rivers with considerably less water compared to the long-term average (run-of-river production), as a result of the dry summer and autumn.

» Water reservoirs filled below average (54.60% as of 7 December 2015 equalling ~4.8TWh, which is ~1.2TWh below the median of the last 18 years).

However, during the first months of 2016, the situation became increasingly less critical

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The measures initiated by Swissgrid in cooperation with the energy industry and European transmission system operators have proved effective, leading to a positive forecast for the energy supply and grid situation in March and April 2016.

Various factors and measures have contributed to the improved situation:

• Joint problem-solving by the energy industry: Since December 2015, a working group from the Swiss energy industry (power plant operators, distribution system operators and traders) has been developing solutions to ease the situation. Swissgrid has also introduced and implemented additional technical and market-oriented measures in close coordination with European transmission system operators.

• Mild temperatures: The unusually mild temperatures this winter have resulted in reductions in grid load and in overall consumption, which has had a positive effect on the energy supply and grid situation. Thanks to frequent rainfall since mid-January, electricity production from run-of-river production has also been higher than normal for this time of the year.

• Restarting of Beznau 2: Since the restarting of Block 2 of the Beznau nuclear power plant on 23 December 2015, a proportion (360MW) of the unavailable base load is once again supplied into the 220-kV grid.

As a result of the mild weather and temperature forecasts up to the start of March, the energy supply and grid situation is expected to be favourable until the middle of March 2016

The Netherlands

General comments on the 2015/2016 winter conditions

The winter period of 2015-2016 was a relatively mild winter. There have not been any difficulties within the Dutch grid during this period.

The expected winter period peak was 18,110MW end of December 2015, the actual peak was somewhat lower 17,854 MW and occurred on 19 January 2016 (17 to 18:00 CET).

The maximum temperature on that day was 0.7 and the lowest -8.0°C.

Specific events and unexpected situations that occurred during last winter

No specific events occurred. As of 21 May 2015 Flow Based Market Coupling method has been introduced within the CWE region. Flow Based Market Coupling is an important step in

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combining the integration of European energy markets and the transition to the feed in 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)

Turkey

General comments on the 2015/2016 winter conditions

2015-2016 Winter conditions were softer and warmer than expected, with little snowfall.

Specific events and unexpected situations that occurred during last winter

In January in one week the gas shortage affected some Natural Gas Power plants.

Burshtyn Island

General comments on the 2015/2016 winter conditions

None

Specific events and unexpected situations that occurred during last winter

For Burshtyn island it is not calculated importable NTC on Ukrainian side.

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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.[23]

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:

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

5. Collect data for the normal monthly average temperatures of the selected cities[24]:

$NMAT_{ij}$, 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

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

23 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

24 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

i = 1 to $\mathbf{NC_{weighted}}$, 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

$CPWNDAT_{10\ 16} = CPWNDAT_{10}$ 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 $\mathbf{TEM_{REF\_SET1}}$

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;

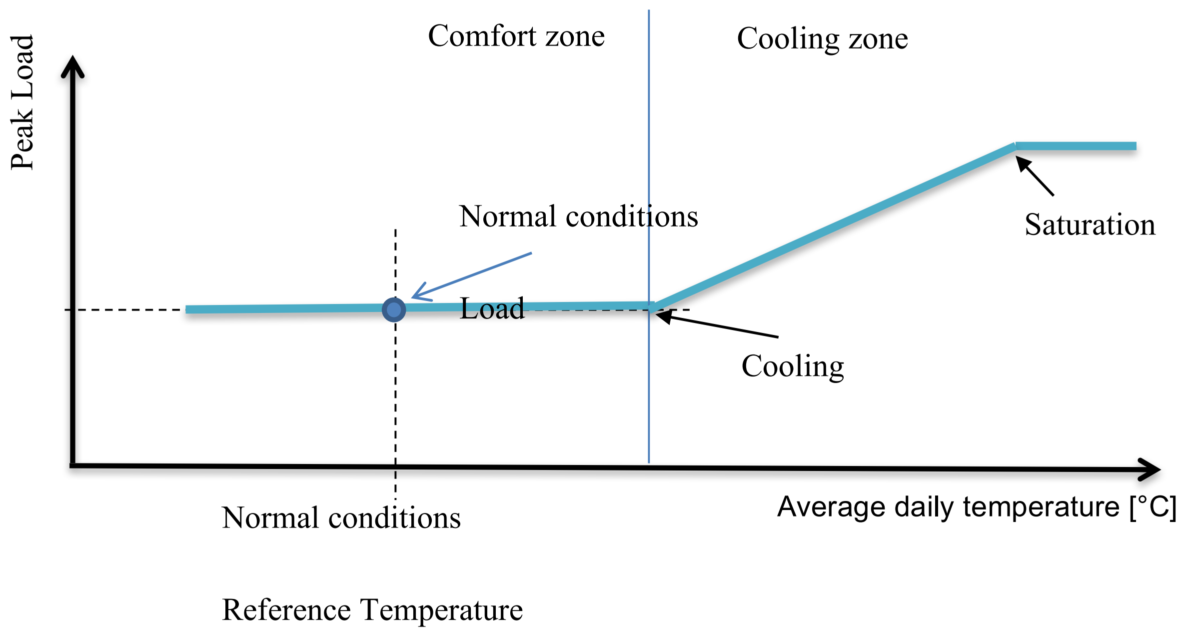
3. Arrange the daily average temperatures in ascending order with corresponding arrangement of the peak load values;
4. Using a step-wise linear regression iteration procedure, the following two important points are defined (for countries concerned by cooling need in Winter):
   - **saturation temperature 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.


Comfort zone
Cooling zone
Peak Load
Normal conditions
Saturation
Load
Cooling
Normal conditions
Average daily temperature [°C]
Reference Temperature

Appendix 4: Questionnaires used to gather country comments

Summer Outlook questionnaire template

Individual country comments: general situation
Overview about the general situation, also compared to previous years, and highlighting specifics such as: *-high levels of maintenance in certain weeks;* *-low hydro levels;* *-low gas storage;* *- any event that may affect the adequacy during the period;* *-etc..*
Please include your comments here.
Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors.
Please include your comments here.
Most critical periods for downward regulating capacity, countermeasures adopted and expected role of interconnectors in managing an excess of inflexible generation.
Please include your comments here.
A short description of the assumptions for input data
Please describe concisely: *1) which assumptions were taken for calculating* NORMAL and SEVERE conditions *(e.g. if an average daily temperature for normal conditions different from population weighted daily values provided) and how the outage rates have been calculated;* *2) how the values of* NTC *have been calculated;* *3) Treatment of mothballed plants*: under what circumstances (if any) could they be made available? *4) Issues, if any, associated with utilising interconnection capacity e.g. existence of transmission constraints affecting interconnectors for export or import at time of peak load (such as maintenance or foreseen transit or loop flows)* *5) Are there any* energy constraint *issues particularly for hydro based systems or any other fuel supply issues which could affect availability (e.g. gas supply issues)?* *6) Any other issues of relevance that are not covered above?* *Please provide feedback on improvements that can be made to the spreadsheet and what difficulties the user had in completing the data.*
Please include your comments here.

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Winter Review questionnaire template

General commentary on the conditions of last period : recalling main features and risk factors of the Outlook Report, please provide a brief overview of last period:
General situation highlighting specifics such as: *- main trends and climatic conditions (temperatures (average and lowest compared with forecast), precipitation, floods/snow/ice);* *- etc.*
Please include your comments here.
Specific events occurred during the last period and unexpected situations:
Please report on specific events occurred during the last period and unexpected situations i.e.: *- **generation conditions:** generation overhaul (planned, unplanned), gas/oil/availability, hydro output, wind conditions (above or below expectations, extended periods of calm weather), specific events or most remarkable conditions (please specify dates)* *- **extreme temperatures**;* *- **demand:** actual versus expectations, peak periods, summary of any demand side response used by TSOs, reduction/disconnections/other special measures e.g. use of emergency assistance, higher than expected imports from neighbouring states;* *- **transmission capacity/infrastructure:** outages (planned/unplanned), reinforcement realised, notable network conditions (local congestion, loop flows etc.)* *- **interconnection capacity/infrastructure:** import/export level, reliance on imports from neighbouring countries to meet demand (you can refer to http://www.entsoe.net/); commentary on interconnector availability and utilisation.* *- **gas shortages;*** *- etc.*
Please include your comments here.

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Appendix 5: Glossary

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);

Control Area: part of the interconnected electricity transmission system controlled by a single TSO;

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.

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;

Forced (or unscheduled) outage: The unplanned removal from service of an asset for any urgency reason that is not under operational control of the respective operator.

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;

N-1 criterion: the N-1 criterion is a rule according to which elements remaining in operation after failure of a single network element (such as transmission line / transformer or generating unit, or in certain instances a busbar) must be capable of accommodating the change of flows in the network caused by that single failure

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 NTC values represent an ex-ante estimation of the transmission capacities of the joint interconnections on a border between neighbouring countries, assessed through security analyses based on the best estimation by TSOs of system and network conditions for a referred period.

Non-usable capacity: 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.;

Pan-European Climate Database: an ENTSO-E database containing per country and per hour, load factors for solar, onshore and offshore wind over between 2000 and 2013. It also includes geographically-averaged hourly temperatures. ENTSO-E is producing a new version of the database that will cover more years (1981-2015) and more countries.

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: The dates and times for which power data are collected. Reference points are characteristic enough of the entire period studied to limit the data to be collected to the data at the reference points.

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

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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;

Renewable Energy Source (RES): energy resources which are naturally replenished on a human timescale, such as sunlight, wind, rain, tides, waves and geothermal heat;

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.[25] 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 for exports/imports to/from countries/areas expected to be available. 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: 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.

Transmission System Operator (TSO): A natural or legal person responsible for operating, ensuring the maintenance of and, if necessary, developing the transmission system in a given area and, where applicable, its interconnections with other systems, and for ensuring the long-term ability of the system to meet reasonable demands for the transmission of electricity.

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

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