GENERATION ADEQUACY

An ASSESSMENT OF THE INTERCONNECTED EUROPEAN POWER SYSTEMS 2008-2015

(Prepared in co-operation with UCTE, NORDEL, UKTSOA, ATSOI)

May 2006

UCTE *ATSOI* *UKTSOA* Nordel

1 EXECUTIVE SUMMARY

1.1 Aims and methodology of the report:

This report sets out the results of the generation adequacy studies over the European electricity system for the period 2008 to 2015. It considers the potential development of electricity demand and installed generation capacity in the countries that are members of the European Transmission System Operators Association (ETSO) and assesses, on this basis, the extent to which generation capacity is adequate to meet demand in the short and long term.

Generation adequacy is one of the issues to achieve security of electricity supply , although it is commonly admitted that it is not sufficient on its own to achieve this objective.

The aims of the report are :

- in the short term to provide an overview of generation adequacy and more generally of system reliability ;
- in the medium long term to provide an appreciation of the amount of new generation investments required or demand side management initiatives that need to be developed to provide equivalent capacity relief. These information are early warning signals to decision-makers and indicate business opportunities for the market players.

The analysis of adequacy is carried over two scenario of generation capacity evolution:

- **Scenario A "Conservative**": only new generation projects known as firm are integrated.
- **Scenario B "Best estimate":** it takes into account future power plants whose commissioning can be considered as reasonably probable according to the information available for the TSOs.

The adequacy analysis is based on the UCTE methodology. This methodology relies on a relatively simple comparison of the "Remaining Capacity" (RC) to the "Adequacy Reference Margin" (ARM), for each country and for the global ETSO.

The Reliably Available Capacity is obtained by deducing from the "Net Generating Capacity" (NGC) all the non-usable or reserve capacity. The Remaining Capacity is the difference between the Reliably Available Capacity and the synchronous reference load.

The Adequacy Reference Margin is defined as the sum of two terms:

- a proportion of the Net Generating Capacity set to 5% or 10% according to the country considered depending on its electric system characteristics,
- a "Margin Against the Peak Load" that compensates the fact that the analysis is made at a predefined synchronous time points (e.g. 3rd Wednesday of January 19:00 and July 11:00) and not specifically at the peak load of the country.

For the global overview of reliability at ETSO level the ARM is calculated as 5% of total NGC plus the sum of individual margins against peak load – knowing that the peak load of each country are not synchronous.

In this method, we consider that capacity exchanges between countries are infinite, which is, of course not the case.

The simplified feature used in this report to characterise the reliability of ETSO system is then, for each of the studied time points:

Remaining Capacity > Adequacy Reference Margin

with ARM = 5% Net Generating Capacity + Margin against the daily peak load

1.2 Global results

The period 2008-2010 shows a decrease of margins as load growth is only partly compensated by generation development. Nevertheless the foreseen power plants commissioning covers a sufficient part of the load increase to ensure that Remaining Capacity remains significantly higher than what is considered as a reasonable security margin in 2010. It may also be underlined that between 2008 and 2010, the part of renewable energy sources increases from 8% to 10% of the generating capacity.

For 2010 – 2015 period, the situation is more tightened. Most of the increase of generating capacity relies on renewable energy sources, mainly wind power. As the availability of this type of generation is only partly guaranteed, depending on wind regimes, it is not sufficient to prevent the global Remaining Capacity from continuing a regular decrease.

Without any additional commissioning program, Remaining Capacity at ETSO level may not respect the Adequacy Reference Margin by 2012. After, the security of the whole ETSO grid would no longer be secured and the need of additional generation would amount to 20GW (approximately 3% of installed capacity) in 2015.

In scenario A confirmed investment decisions seem sufficient, at ETSO level, to allow a reasonable level of adequacy from now to 2012. After 2012, if further investments are not decided in due time, the reliability of the whole system cannot be considered as achieved.

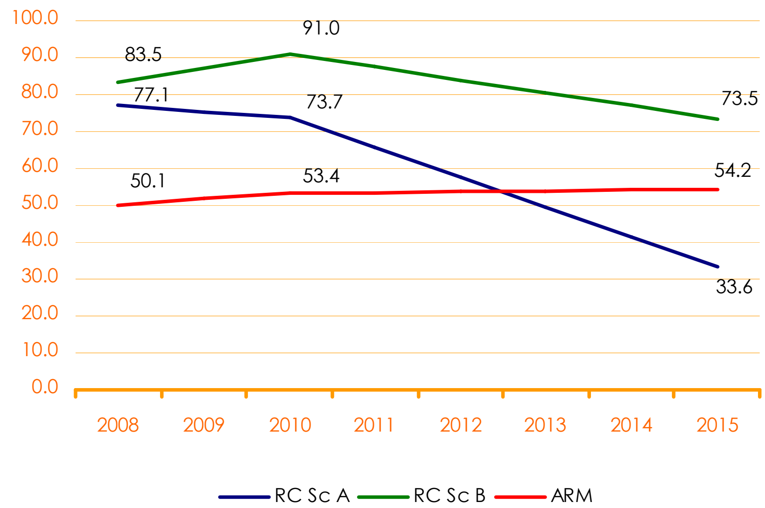
In addition to the uncertainties on future developments there are also uncertainties on future plants retirement which should more particularly result from CO_2 trading and Large Combustion Plants European Directive on.

The decisions of plants closure, difficult to forecast as they are usually notified to TSOs with very short notice, are likely to affect the margins.

Scenario B gives a more optimistic view of the situation. Estimated possible plants commissioning would allow to fulfil the ARM criteria and keep a reasonable level of risk for the whole ETSO system until 2015.

The following graphs illustrates above conclusions:

Figure 0	ETSO – Remaining capacity against Adequacy Reference Margin – Results in GW – January 19:00



1.3 Regional results

<u>NORDEL (without Iceland)</u>

Reliability for NORDEL block seems not to be at risk over the whole period.
In normal temperature conditions, NORDEL block can be net exporter. In severe temperature conditions, there is a risk that the peak load cannot be met without imports.
The estimated generation investment plans in Scenario B contribute with additional 700 MW to the peak load capability.

<u>United Kingdom:</u>

GB does not meet the ARM criteria in Scenario A or post 2009 in Scenario B. Any projected shortfall should not be interpreted as a shortage of capacity but as an assessment of the amount of new capacity that is likely to be required over that which is already confirmed as firm.

The additional support available from imports should also be taken into consideration. Taking these imports into account could increase the remaining capacity by some 2.5GW.

<u>Ireland:</u>

Northern Ireland plant margins are tight with respect to ARM in the short term. Import capacity can provide some relief, but this can be offset by equivalent export to the Republic of Ireland.

In the short term, the generation adequacy position is manageable. **From 2010 onwards, the situation can be managed through a combination of additional generation capacity and reliance on external generation**.

<u>Baltic countries:</u>

Adequacy feature is not achieved from 2010 to 2015 for winter reference time. Relying on interconnection and on generating investments already foreseen can helps to cover the ARM index.

Main UCTE block[1]:

ARM feature is respected all over the period 2006-2010. But in 2015 in the conservative scenario, there will be a lack of 11 GW to fulfil the indicative adequacy criteria. This block, globally exporter today, is expected to have a decrease in its potential for export, and could show a need for import in 2015.

Spain + Portugal block:

From 2006 to 2008, the adequacy index is respected for January reference time. After 2010, ARM feature is no longer met and the lack of generating capacity amounts to 12 GW in summer 2015. Development of local generation and reinforcement of interconnections are needed to increase the reliability of Spanish and Portuguese systems.

Italian block:

Thanks to the commissioning of conventional thermal plants – one of the possible consequences of the 2003 black-out – the remaining capacity of the block is significantly improving. The ARM is met from January 2006 to January 2015. The adequacy is just achieved for summer reference time 2015.

South eastern UCTE[2]:

The remaining capacity of the block is low and reliability is already not ensured in 2006, as the margins are 3 GW below ARM for summer load. The situation will be worsened in the future if investments are not realised.

Centrel block[3] :

This block presents a Remaining Capacity significantly higher than the Adequacy Reference Margin. This situation is stable from 2006 to 2008, and even improves in 2010. It remains sufficient in 2015 without any extra commissioning. CENTREL is the only block that seems to have a long-term export-orientated position.

Romania + Bulgaria block:

Generation capacity is decreasing slowly from 2006 to 2010 but adequacy is achieved for this period. In 2015 additional investments up to 2 GW are needed to meet the ARM.

---

[1] Main UCTE block: Belgium, Germany, France, Slovenia, Croatia, Luxembourg, Netherlands, Austria, Switzerland, Bosnia Herzegovina.
[2] South eastern UCTE block is made of Greece, Serbia Montenegro and FYROM.
[3] CENTREL: Czech Republic, Poland, Hungary, Slovakia, Western Ukraine

2 METHODOLOGY

2.1 Introduction

Developments in the European energy market and changes in the overall European generation adequacy during recent years have considerably increased the interest in power balances in a broader European scale.

Such concern is taken into consideration in the EU Directive 2005/89/CE on Security of Supply and Investment Decisions which request each member state to issue a yearly report on system security.

Such forecasts are nowadays performed at national level, either by the TSO's, by Regulators or by State Agencies; however the compatibility of each analysis with other national balances is not necessarily checked.

Against this background, ETSO has decided in 2004 that it would be useful to collate a European power balance, in close collaboration with the regional TSO's associations, which for a number of years have carried out power balance analysis and forecasts. A first report covering the period 2007-2015 has been issued in 2005.

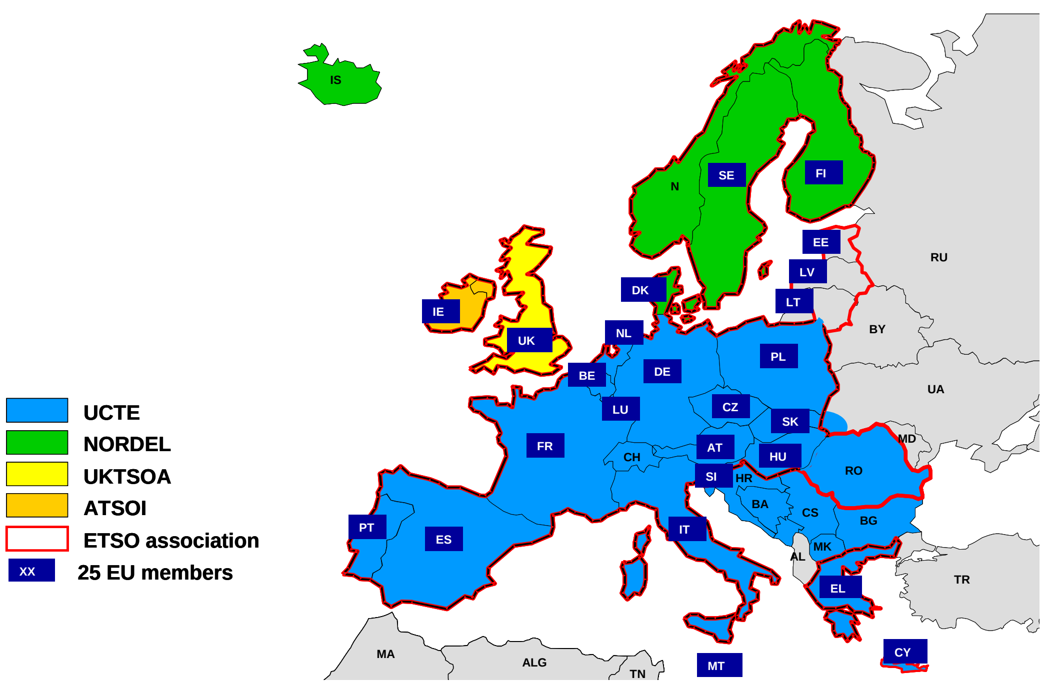
This second report is based on the contributions from **UCTE, NORDEL, ATSOI and UKTSOA, and, for the first time, Baltic TSO's.**

The main aims of these reports are :

- In the short term to provide an overview of generation adequacy and more generally of system reliability;

- In the medium long term to provide an appreciation of the amount of new generation investments required or demand side management initiatives that need to be developed to provide equivalent capacity relief. These informations are early warning signals to decision-makers and indicate business opportunities for the market players.

Perimeter of the study:



Country Name	Country Code	Block	Sub-group
Austria	AT	UCTE	Main-UCTE
Belgium	BE	UCTE	Main-UCTE
Bosnia Herzegovina	BA	UCTE	Main-UCTE
Bulgaria	BG	UCTE	Romania & Bulgaria
Croatia	HR	UCTE	Main-UCTE
Czech Republic	CZ	UCTE	CENTREL
Denmark	DK	NORDEL	
Estonia	EE	Baltic Countries	
Finland	FIN	NORDEL	
Former Yugoslav Republic of Macedonia	MK	UCTE	South Eastern UCTE
France	FR	UCTE	Main-UCTE
Germany	DE	UCTE	Main-UCTE
Great-Britain	GB	GB	
Greece	GR	UCTE	South Eastern UCTE
Hungary	HU	UCTE	CENTREL
Italy	IT	UCTE	Italy
Latvia	LV	Baltic Countries	
Lithuania	LT	Baltic Countries	
Luxembourg	LU	UCTE	Main-UCTE
Netherlands	NL	UCTE	Main-UCTE
Northern Ireland	NI	IRL	
Norway	N	NORDEL	
Poland	PL	UCTE	CENTREL
Portugal	PT	UCTE	Spain & Portugal
Republic of Ireland	ROI	IRL	
Romania	RO	UCTE	Romania & Bulgaria
Serbia and Montenegro	CS	UCTE	South Eastern UCTE
Slovak Republic	SK	UCTE	CENTREL
Slovenia	SI	UCTE	Main-UCTE
Spain	ES	UCTE	Spain & Portugal
Sweden	S	NORDEL	
Switzerland	CH	UCTE	Main-UCTE
Western-Ukraine	UA-W	UCTE	

2.2 General features

2.2.1 Abbreviations

Abbreviations below are used in the report.

Abbreviation	Complete title
ARM	Adequacy Reference Margin
BALTIC COUNTRIES	Baltic Countries is a regional group of three Transmisison system operator companies: - OÜ Põhivõrk for **Estonia** - AS Latvenergo for **Latvia** - LIETUVOS ENERGIJA AB for **Lithuania**
CENTREL	CENTREL is a regional group of four transmission system operator companies: - ČEPS, a.s. **- of the Czech Republic;** - Hungarian Power System Operator Company MAVIR Rt.of **Hungary;** - PSE-Operator S.A. **of Poland;** - Slovenská elektrizačná prenosová sústava, a.s. – SEPS a.s. - **of Slovakia**
ETSO	European Transmission System Operators
JIEL	JIEL is the name of UCTE control block composed by three transmission system operator companies: - MEPSO **of Macedonia;** - EKC and EPCG of **Serbia and Montenegro**
Main UCTE	The main UCTE is a regional group of transmission system operator companies: - VERBUND-Austrian Power grid AG of **Austria** - ELIA of **Belgium**, - NOS BIH of **Bosnia Herzegovina** - HEP of **Croatia** - RTE of **France** - EnBW TNG, E.ON Netz, RWE TSO Strom, VE-T.I of **Germany** - CEGEDEL of **Luxembourg** - TenneT of **the Netherlands**, - ELES of **Slovenia** - ETRANS of **Switzerland**
NGC	Net Generating capacity
NORDEL	Nordel is an association of the TSOs in the Nordic countries: - Energinet.dk in **Denmark,** - Statnett in **Norway,** - Fingrid in **Finland,** - Landsnet in **Iceland** *(Iceland is not included in this analysis)* - Svenska Kraftnät in **Sweden**
RAC	Reliably Available Capacity
RC	Remaining Capacity
RL	Reference load
SAF	System Adequacy Forecast
SAR	System Adequacy Retrospect
TSO	Transmission System Operator
UCTE	Union for the Coordination of Transmission of Electricity

2.2.2 Methodology for assessment of generation adequacy

Generation adequacy assessment consists in investigating the ability of the generating units to match the system load evolution.

The basic methodology of these exercises consists of comparing the **installed generating capacity** with the actual or forecast load, taking into account unavailable or unusable generation capacity resulting from outages, overhauls and reserves required in operational time frame.

At the national level two methods are used:

- a **deterministic approach** which indicates the total generation likely to be needed at peak load hours.
- a **probabilistic approach**, which takes into account the random character of the different terms of the power balance (load, unit availability, etc) and allows the calculation of the probability that the system may not be able to supply demand; the results are often characterized by a loss of load expectation (LOLE).

The individual associations currently use a number of approaches but there is no common approach within the European power system to assess generation adequacy i.e. to **estimate if there is sufficient capacity to supply demand in the various member states.**

ETSO has decided in the interests of efficiency to adopt the UCTE methodology for presenting the EU electricity industry position. The UCTE methodology is a deterministic approach focussed on power balance at time of peak load, which allows the assessment of the generation adequacy on the basis of the reserves available at this time (expressed as the ratio " remaining capacity" over installed capacity). Appendix gives more details on the structure of the power balance.

The load corresponds to a common synchronous reference for the entire ETSO network. The selected reference points are the third Wednesday of January at 19.00 and the third Wednesday of July at 11.00; the load forecast is based upon the assumption of normal climatic conditions.

The resulting balance, called "remaining capacity" (RC), can be interpreted as the capacity that the system needs to cover the difference between the peak load of each country and the load at the synchronous reference time, and, at the same time to cover demand variations (resulting for example from weather conditions) and longer term unplanned outages which the power plant operators are responsible to cover with additional reserves.

This positive or negative balance, indicating whether a certain area or region has generating capacity that it could export without endangering its own reliability, or whether it needs to import power in order to ensure reliable supplies.

Due to significant differences among the different power systems in Europe it is very difficult to define a common margin of spare generation capacity over and above peak demand to ensure a reasonable level of security. Nevertheless the following approximations, issued from analysis of the random factors which affect each of the national system, have been considered as a reasonable .

Considering a level of risk for each national system corresponding to 1% is consistent for the UCTE system and some national systems with RC at peak load representing 5% of the net generating capacity.

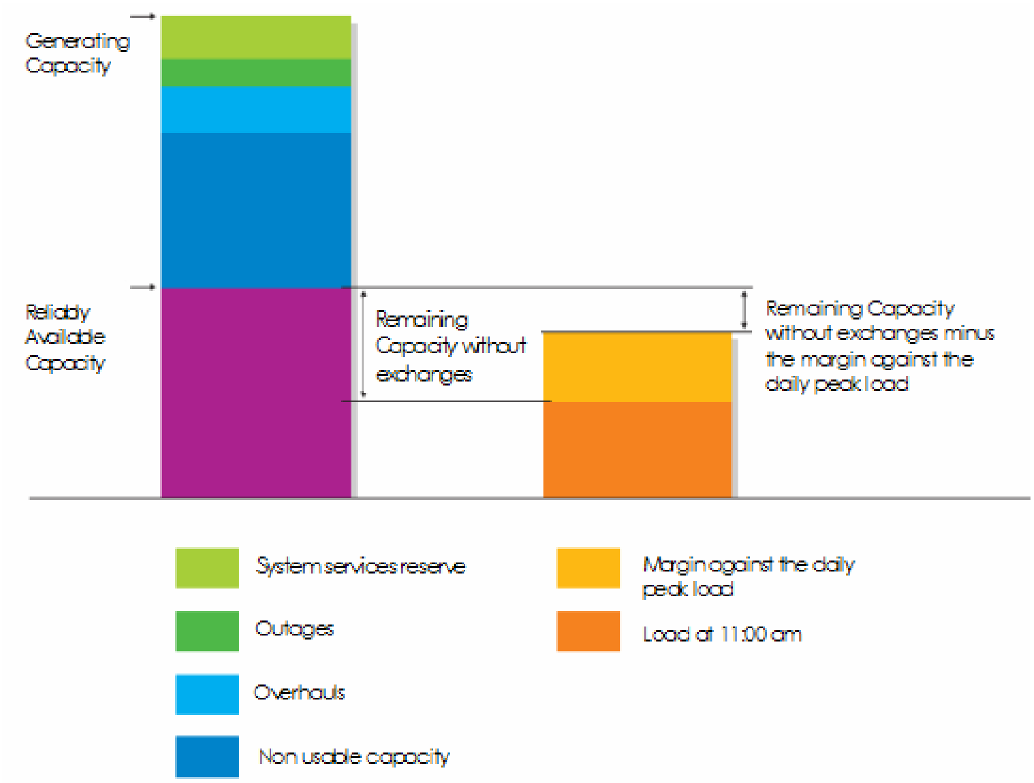
For some other national systems, more sensitive to random factors (load variations or unavailability of generation), RC at peak load should represent around 10% of the net generating capacity. Small, isolated or weakly interconnected systems need larger reserves to enable the same security as in large area.

These indicative level of margins are called Adequacy Reference Margin (ARM). Thus when considering individual countries, **generation adequacy will be assessed on the basis of the comparison between RC and ARM**. ARM is not used as an indication for the Nordel system. The additional peak demand between normal and cold temperature conditions occurring once in ten years is used instead of ARM.

This method is also applied to assess generation adequacy for the whole UCTE system or for larger geographical blocks ; in this case the synchronous peak load of the blocks is estimated by the sum of the peak loads of the individual countries.

This approximation leads on one hand to an overestimation of the peak load for the largest geographical blocks and to a conservative view of the level of adequacy. On the other hand, considering the synchronous peak load of large size blocks leads to rely on the assumption that it is always possible to carry where needed the generating power available in a country in any other country of the block, whereas the capacities of the transmission system actually limit these possibilities.

Here below is shown the graph illustrating the Power Balance according to UCTE methodology:



Another step is to take into account the role of interconnections in security of supply. Imports can secure a system, provided that export capacities exists in the neighbouring systems and that interconnections capacities allow for the associated transits.

In order to estimate the export capacities or import need a simplified approach consists in comparing the Remaining Capacity to the ARM:

Remaining Capacity > ARM means possibility of export
Remaining Capacity < ARM means potential need of import[4]

The comparison of RC with the transfert capacities gives a first estimation of the possible contribution of interconnections to security of supply.

However, where there is a risk of a regional energy shortage (especially for systems depending on hydro conditions like the Nordel region), then specific calculations must to be performed in order to check if the available energy is sufficient to supply the yearly consumption.

[4] In the context of the report "need of import" means potential need of import at peak load

2.2.3 Scenarios of the Generation Adequacy

Because longer term forecasts are subject to higher uncertainties, considering that today it takes at least two to three years to build new power plants, TSO's have developed long term **scenarios** whose aim is to give an evaluation of the range of uncertainties, and an evaluation of the risks concerning security of supply over the ten coming years.

The first scenario is called "conservative scenario" (scenario A); it only takes into account the new power plants whose commissioning can be considered as sure : plants under construction or whose investment decision is notified as firm to the TSOs.

This scenario shows the evolution of the potential unbalances if no new investment decision were taken in the future. It allows to identify the amount of investments which are necessary over the period to maintain a targeted standard of security of supply.

The second scenario is called "best estimate scenario" (scenario B), it takes into account future power plants whose commissioning can be considered as reasonably probable according to the information available for the TSOs : commissioning resulting from governmental plans or objectives, concerning for example the development of renewable sources in accordance with the European legislation, or estimation of the future commissioning resulting from the requests for connection to the grid of from the information given by producers to the TSOs. This scenario gives an estimation of potential future developments, provided that market signals give adequate incentives for investments.

It should be stated at this stage that in the cases where the assessments for 2010 and 2015 fall short of the required generation adequacy margin, this should not be interpreted as a forecast of expected generation inadequacy. Instead, it reflects that, at present, there are currently insufficient generation projects identified by the TSOs to meet this margin.

2.2.4 Scope of the report

The ETSO generation adequacy projections cover years 2008 – 2010 - 2015 and consider for each year peak load situations for the months of January and July (except for NORDEL, where the summer balance is not critical).

Because the analysis of the situation inside each regional organisation is basically the duty of the regional TSO associations, the present report focuses on the overall situation of the European power system and on the mutual assistance and trading opportunities that the regional blocks can provide to each other using interconnection capacities.

3 GENERATION ADEQUACY

3.1 MAIN TRENDS FOR ETSO BLOCK

The consumption growth by 2010 is of 1.7% per year for the winter load and 1.9 % per year for the summer load. By 2015 it is of 1.5% in winter and 1.7% in summer.

The generation capacity increase expected in scenario A is of 17 GW by 2010 (1.1% per year) and 17 GW from 2010 to 2015 (0.5% per year).

The new installed capacities are substantially based on renewable sources. Due to its relatively low availability, the available generation capacity increases more slowly than the installed capacity.
By the same time, the retirement of nuclear power plants reaches 3 GW by 2015.

In scenario A, the adequacy criterion is no longer met from 2012 and the lack of available generation capacity reaches 20 GW in 2015.

In scenario B, the adequacy criterion is met until 2015.

Figure 1	Main ETSO – Remaining Capacity against Adequacy Reference Margin – Results in GW – January 19:00

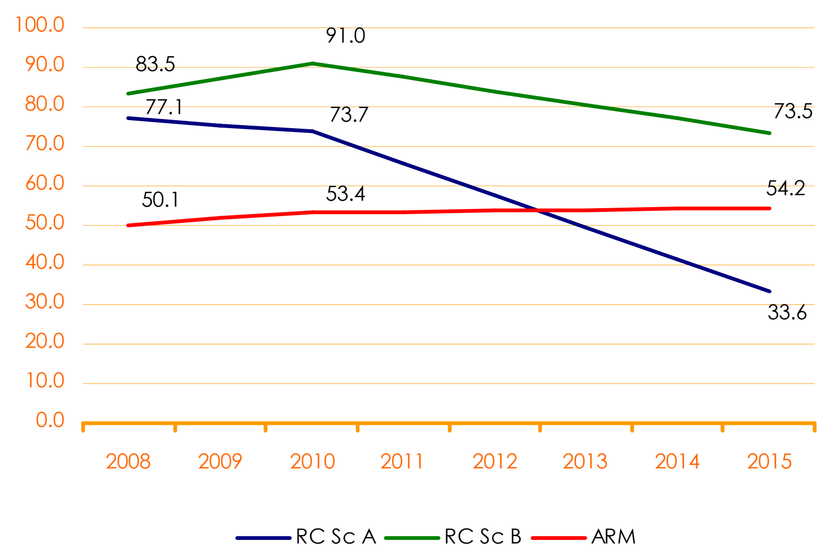
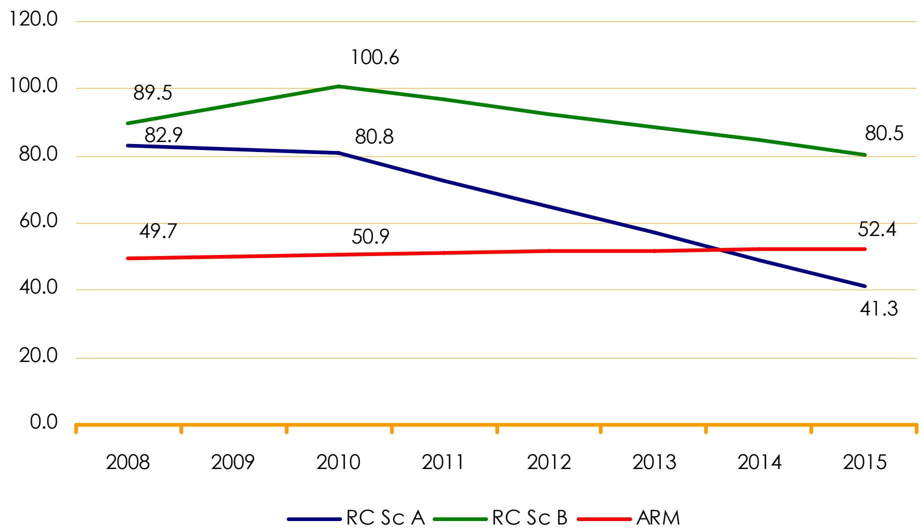


Figure 2	Main ETSO (without NORDEL)– Remaining Capacity against Adequacy Reference Margin – Results in GW – July 11:00



3.2 Comparison with previous forecast

In the former ETSO Generation Forecast 2007-2015, ARM criteria was no longer met from 2010 in scenario A. In the present ETSO Generation Forecast 2008-2015, the mismatch between RC and ARM is expected in 2012.

This result is due to a significant increase of Remaining Capacity observed between the two studies: In 2015, RC in scenario A is 23GW higher than last year results (26 GW in scenario B).

The shift of risky situations of approximately 2 years is also corroborated by the results of SAF UCTE studies (In UCTE SAF 2008-2015 the mismatch between RC and ARM is expected from 2013-2014, while it was reached in 2010 in the previous issue).

This variation may be explained as follows:

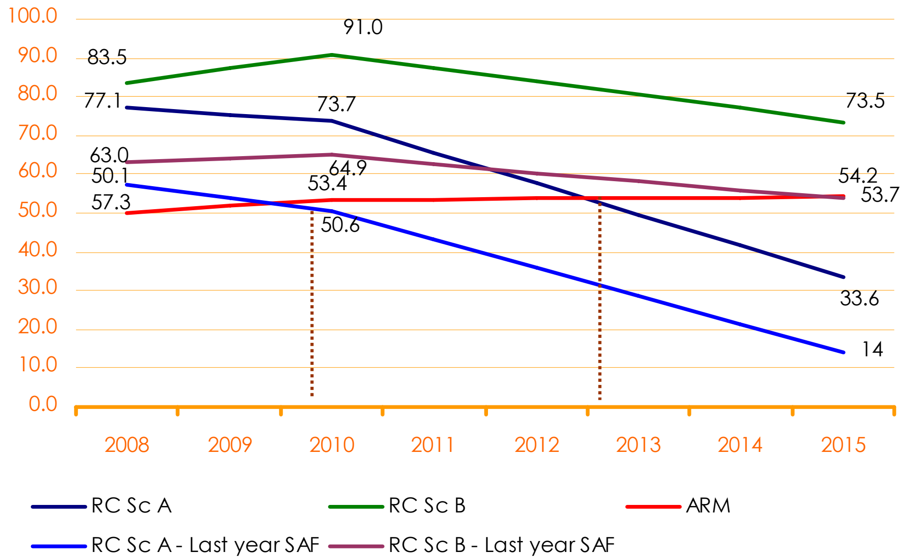
- The integration of the Baltic Countries in the perimeter of the study brings new remaining capacities (around 10 GW of generation capacity for 5 GW of load in 2010).
- Commissionnings in Italy, in Spain and in Portugal not foreseen in last year study induce an increase of the NGC by 11 GW in 2015. This results on a RC increasing by 9 GW in these blocks.
- The update and consolidation of the data of Ireland and the United Kingdom increases the generation capacity by +1.2 GW in 2010.

Table below gives the differences of global index for ETSO block with last year results. (detailed data are exposed in Appendix 1, Table 4)

January 19 :00	GW	ETSO block scA	ETSO block scB
NGC	2010	**22.2**	**28.6**
	2015	**17.8**	**24.0**
RAC	2010	**23.0**	**26.1**
	2015	**23.6**	**24.3**
RL	2010	**0.0**	**0.0**
	2015	**4.0**	**4.4**
RC	2010	**23.1**	**26.1**
	2015	**19.7**	**19.9**

Results exposed in the graph below are consistent with a "pro forma" vision of last year. A detailed table is presented in Appendix 1

Figure 3	ETSO – Remaining capacity against Adequacy Reference Margin – Results in GW – Comparison with ETSO Forecast 2007-2015 January 19:00



3.3 Regional blocks analysis

3.3.1 UCTE MAIN BLOCK

Generation adequacy

The winter load growth is of 2% per year by 2010 and 1% by 2015.

The generation capacity increase expected in scenario A is of 6 GW from 2008 to 2010 (0.3% per year) and 4 GW from 2010 to 2015 (1% per year).

Expected new plants are mostly renewable energy sources.

In scenario A, the adequacy criteria is no longer met from 2011 and the lack of available generation capacity reaches 12 GW in 2015.

Austria, Switzerland and Bosnia Herzegovina and Luxembourg are the countries that individually meet the ARM in 2015.

In scenario B, the adequacy criteria is met until 2015.

Compared to previous forecast of last year's studies, the current forecast for 2010 indicates a generating capacity 6 GW higher, a better availability for approximately 4 GW and a load 3 GW lower. The Remaining Capacity expected for 2010 has consequently improved by approximately 13 GW in winter 2010.

Figure 4	Main UCTE – Remaining Capacity against Adequacy Reference Margin – Results in GW – January 19:00

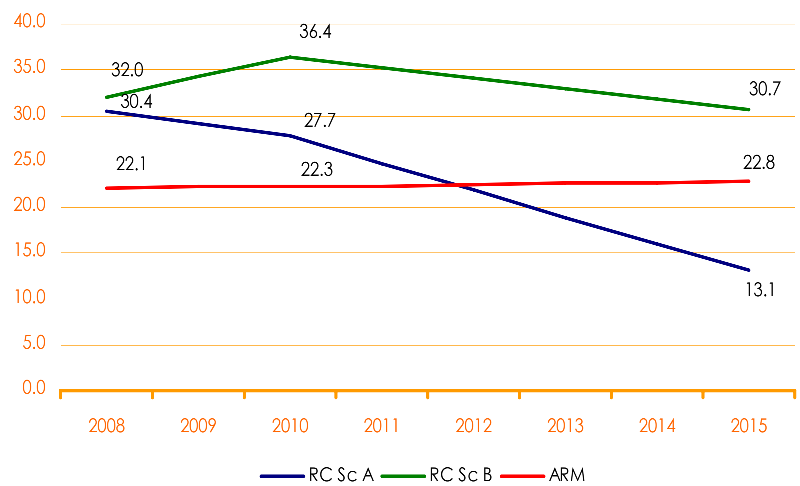
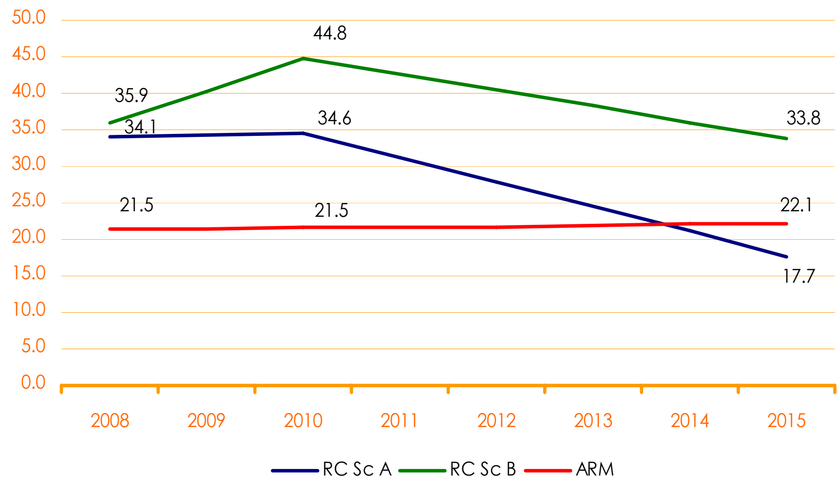


Figure 5	Main UCTE – Remaining Capacity against Adequacy Reference Margin – Results in GW – July 11:00



Role of interconnections

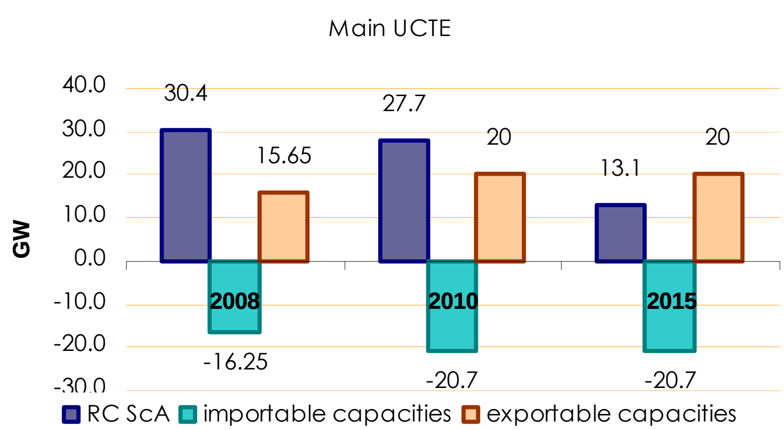
This block plays a key role in the European power system due to its size and to its central geographical position.

Exports from this block are currently very important to secure the supply of the surrounding areas.

In scenario A the export capability can be critical in winter time depending on operating and meteorological conditions; imports could be necessary in extreme circumstances after 2010.

These export capabilities should be maintained till 2010 if the new plants expected in scenario B are confirmed.

Figure 6	Main UCTE – Remaining Capacity compared to Net Transfer Capacities – Results in GW January 19:00



3.3.2 CENTREL BLOCK

Generation Adequacy

The load increases only by 1 GW from 2008 to 2010.

The development of conventional thermal plants and renewable energy sources, though the retirement of nuclear, increases the Reliably Available Capacity until 2010.

Margins should maintain after 2010 thanks to improving the capacity of nuclear power plants Hungary and Slovak Republic) and conventional power units (Poland and Hungary).

In scenario A, the adequacy criteria is met until 2015 with a residual margin of approximately 6 GW in winter.

In scenario B, the adequacy criteria is met until 2015.

Inside the CENTREL block, Poland and Czech Republic meet the ARM with comfortable margin while Slovak Republic and Hungary do not meet the individual ARM.

Figure 7	CENTREL – Remaining Capacity against Adequacy Reference Margin – Results in GW – January 19:00

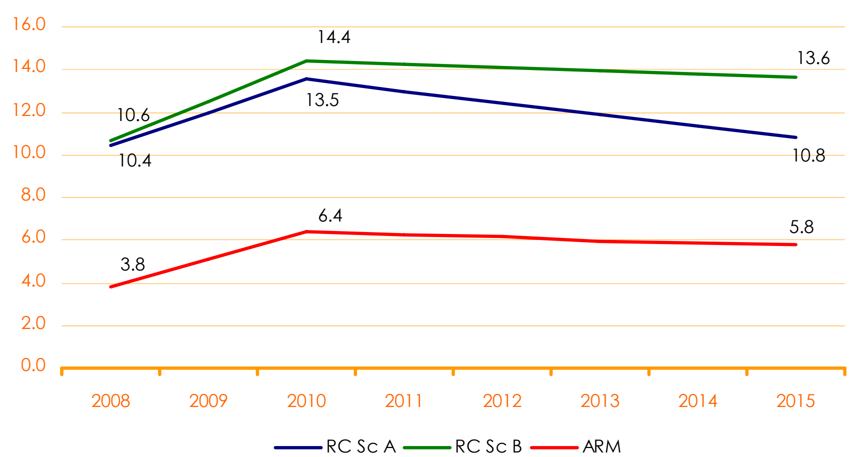
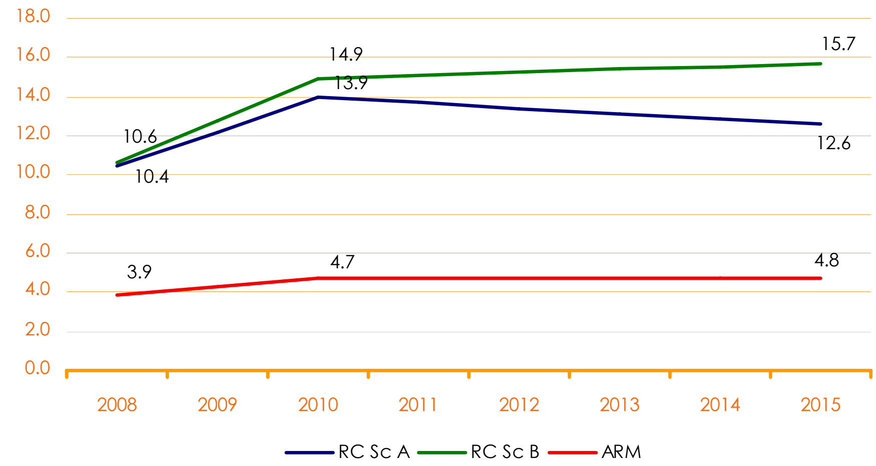


Figure 8	CENTREL – Remaining Capacity against Adequacy Reference Margin – Results in GW – July 11:00



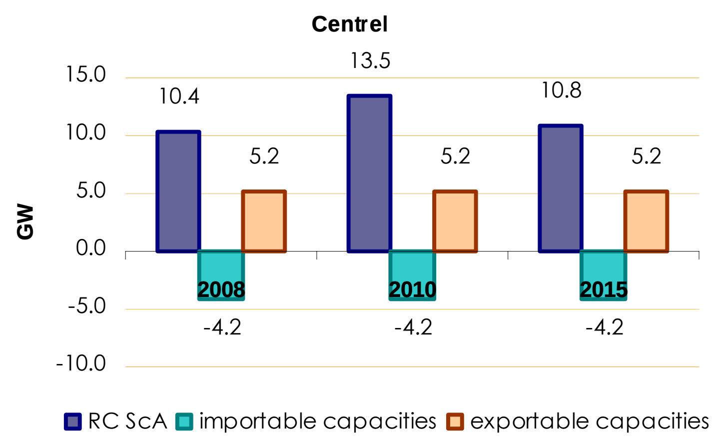
Role of interconnections

CENTREL should be able to help surrounding areas whose situation at peak load seems to be less favourable. Nevertheless the interconnection capacities of CENTREL, which is approximately 5 to 6 GW, limit the potential of export identified by the remaining capacity.

Predominant westward flow of electricity in the region causes congestion at the network interface with the UCTE main block throughout the year. Export capacities are limited to 3500 MW.

The interconnection with NORDEL is limited to 500 MW.

Figure 9	CENTREL – Remaining Capacity compared to Net Transfer Capacities – Results in GW January 19:00



3.3.3 NORDEL

Generation Adequacy

The NORDEL (excluding Iceland) figures are based on forecasts of peak demand in separate countries. The simultaneous reference load i.e. the Nordic peak load is expected to be 1500 MW lower than the sum of individual peaks.

- **In normal temperature conditions the synchronous peak load can be met without import beyond 2015 in both Scenarios.**
- If the temperature corresponding to a day that can be statistically expected to occur once every 10 years is considered, the demand is estimated to increase by about 3500 MW compared to the normal temperature conditions including estimated impact of demand response of about 1000 MW.

  This means that in severe temperature conditions there is a risk that the synchronous peak load cannot be met without import. This is especially the case in the years before 2010 i.e. commissioning of the new nuclear power unit in Finland and in 2015 in Scenario A.

Figure 10	NORDEL – Synchronous peak load in average conditions compared to Reliably Available Capacity –Results in GW – January 19:00

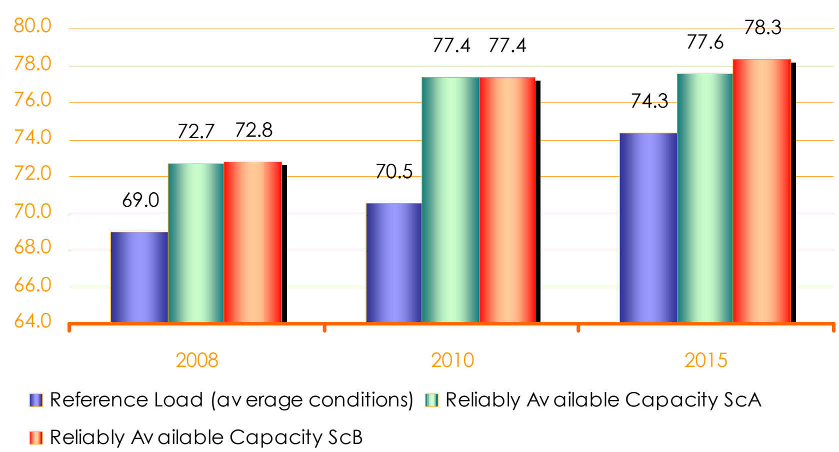
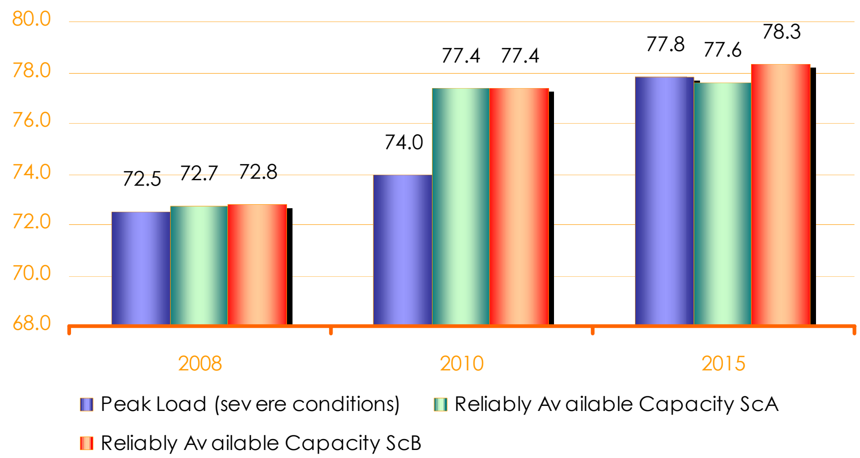


Figure 11	NORDEL – Synchronous peak load in severe conditions compared to Reliably Available Capacity –Results in GW – January 19:00



Role of interconnections

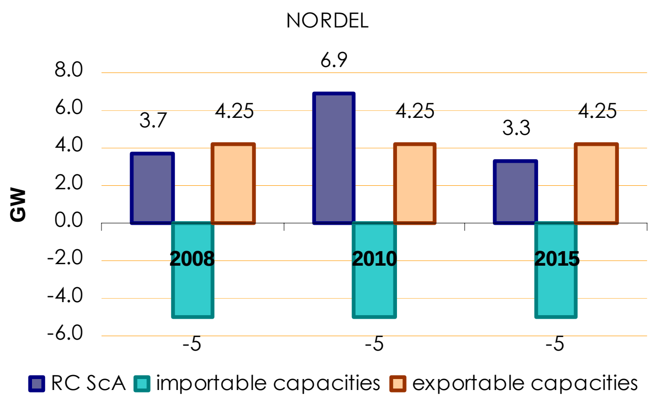
Interconnection capacity with the UCTE countries (Germany, Poland and the Netherlands)is 3200 MW (import) and 3900 MW (export) in both scenarios.

The importable interconnection capacity from outside UCTE, i.e. the Baltic countries and Russia, is 1800 MW during the whole period. Corresponding exportable capacity is 350 MW.

The interconnection capacity is sufficient to cover the eventual import needs in severe temperature conditions. Availability of imports depends on the simultaneous generation adequacy of the exporting countries and the market price differences. In Poland, there is a surplus of generation capacity but the utilisation may be limited because of environmental reasons. In Germany the power balance is assessed to be more stressed and the import possibility from the main UCTE block may be reduced in the coming years.

The interconnection capacity may restrict the export from the Nordic system in 2010 in normal temperature conditions.

Figure 12	NORDEL – Remaining Capacity at peak load in average temperature conditions (Scenario A) compared to Net Transfer Capacities – Results in GW January 19:00



3.3.4 GREAT BRITAIN

Generation Adequacy:

Scenario A

The projected generating capacity (presented in tables of Appendix 1) reflects the plant currently available and that which is under construction, taking into account all announced closures. It is a conservative view and does not try to capture plant that may be expected to be built as a result of the efficient operation of the market to meet the required increments in capacity.

Scenario B

This scenario is not the best view as seen by the GB TSO but is a variant on Scenario A, which also captures plant not yet under construction but which has received planning consent.

Both scenarios A and B are compared to the best view of growth in load expected on the transmission network. Any shortfall in plant capacity should not be taken to indicate security of supply problems for the system, but rather to show how much new capacity will be required to be built to bridge the gap between existing plant capacity and that required to meet the growth in peak demand.

Great Britain is projected to have sufficient capacity to meet the reference load in 2008 where the reference load is that expected to occur in Average Cold Spell conditions, defined in broad terms as a day when temperatures are one or two degrees Celcius at noon across the country. At this level of demand there is still a remaining margin of some 3861MW.

The margin is below the adequacy reference margin of 4412MW, as defined by the UCTE methodology (5% of installed capacity plus the margin between peak load and reference load**) but the GB SO believes that it is adequate.** Specifically the gross plant margin in Great Britain (that is the ratio of 'installed capacity' to 'peak demand') is projected to be in 2008 approximately 21%, excluding the capacity of the interconnector with the UCTE main block. It is expected to be approximately 25% if that capacity is included. **Typically a 20% figure is considered adequate for security of supply of the British system.**

As mentioned above, it is important not to misinterpret the projected shortfall in remaining capacity, and associate this with adverse impacts on the security of electricity supply either in the short term (2008) or in the longer term (2010 and 2015). For example the projected shortfall against the adequacy reference margin in 2008 of some 551MW should be seen in the context of the potential level of imports that can be provided by the 2000MW link with the UCTE main block.
The UCTE main block itself is expected to have a surplus of some 8210MW relative to the Adequacy Reference Margin (ARM) in 2008 and some 30400MW in relation to the reference load. Seen in this context **there is adequate capacity to meet peak demand**.

For the longer term (2010 and 2015), the estimated shortfalls against the Adequacy Reference Margin should not be interpreted as reflecting an expected shortage of capacity to meet demand but as an assessment of the amount of new capacity that is likely to be required to be installed over and above that already considered as relatively firm.

Given the limited assumptions concerning plant closures over this period, these assessments could be considered as a minimum in terms of new plant construction. However, **the balance between new plant construction and plant closures will be a function of developments of market prices over this period**.

Remaining Capacity vs. ARM

Figure 13	GREAT BRITAIN – Remaining Capacity against Adequacy Reference Margin – Results in GW – January 19:00

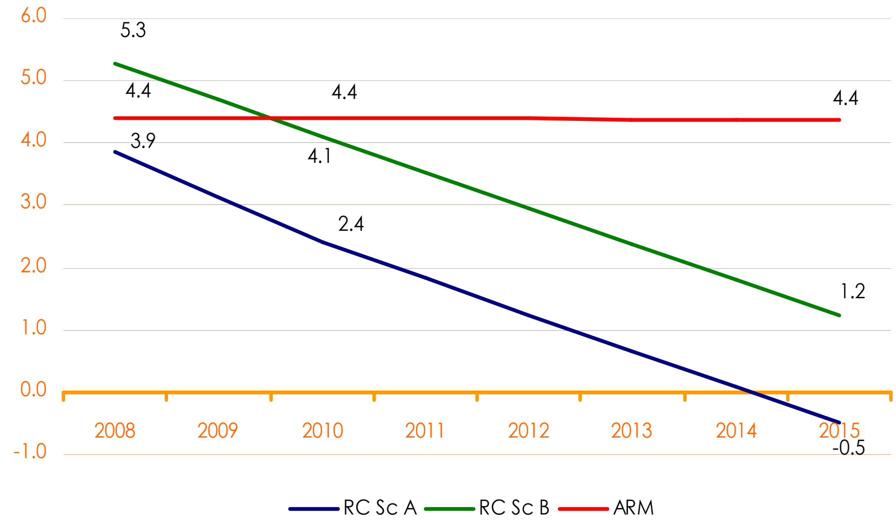
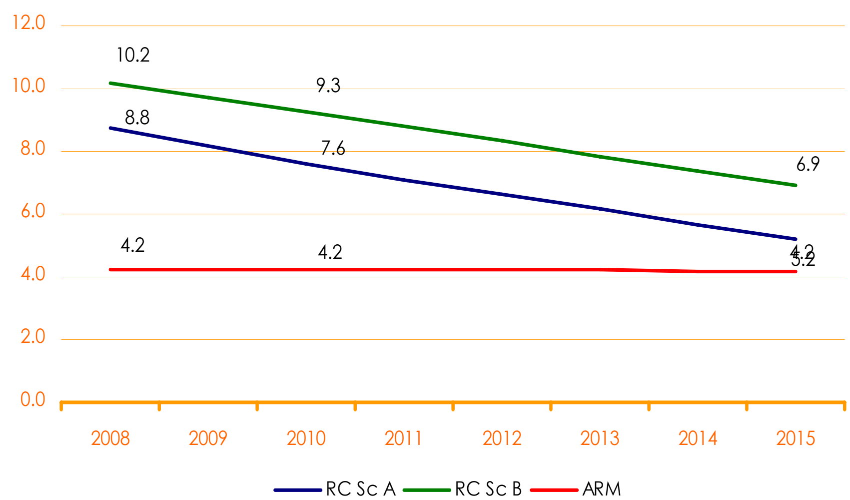


Figure 14	GREAT BRITAIN – Remaining Capacity against Adequacy Reference Margin – Results in GW – July 11:00



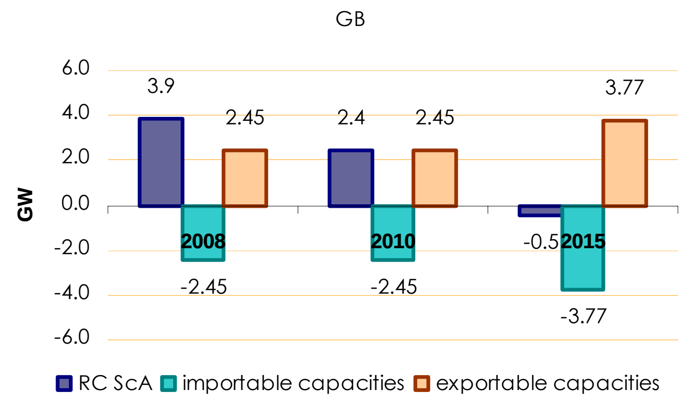
Role of Interconnections:

The GB-France Interconnector, which connects Great Britain and the UCTE Main Block, has a capacity of 2000MW in both directions.
Flows of power across this link are very much a function of the price differential between Great Britain and Continental Europe. Physical restrictions on imports from the full 2000MW capacity of the link, as a result of congestion within England occur only under certain outage conditions on the England and Wales system. This occurs about 5% of the year and not usually at times of peak demand.

Hence it is expected that imports could be available to the full 2000MW level during system peak. The level actually provided would depend on relative market prices, which at peak time are likely to reflect partly the levels of generation adequacy in the two markets. **The continuing levels of adequacy shown by this study for the UCTE Main Block would suggest that such capacity would be available until at least 2010**.

Similarly exports to Northern Ireland will depend on relative market prices and available capacity. **The current export capacity of 450MW to Ireland needs to be taken into consideration in assessing the adequacy of imports from UCTE Main Block to meet demand in Great Britain**.

Fig. 15	GREAT BRITAIN – Remaining Capacity compared to Net Transfer Capacities – Results in GW - January 19:00



3.3.5 REPUBLIC of IRELAND - NORTHERN IRELAND

Generation adequacy

Republic of Ireland

The Republic of Ireland figures indicate that the generation adequacy position should be manageable from 2006 up to 2009 provided that **new generation** currently under construction comes on stream as expected, that **plant availability** performance is in accordance with forecasts, and that there are **no unexpected plant closures** from the current portfolio.

By 2010, the generation adequacy position can be managed through a combination of additional generation capacity and reliance on external generation.

Northern Ireland

There is an underlying growth rate of circa 2% in Northern Ireland's peak demand. The 19:00 system demand increases from 1619MW to 1892MW over a 10 year period. **Plant margins with respect to the UCTE Adequacy Reference Margin are tight in the short term with surpluses reducing to zero by 2008, and a deficit of –300MW is reached by 2015**.

Remaining Capacity vs. ARM

Figure 16	IRELAND – Remaining Capacity against Adequacy Reference Margin – Results in GW – January 19:00

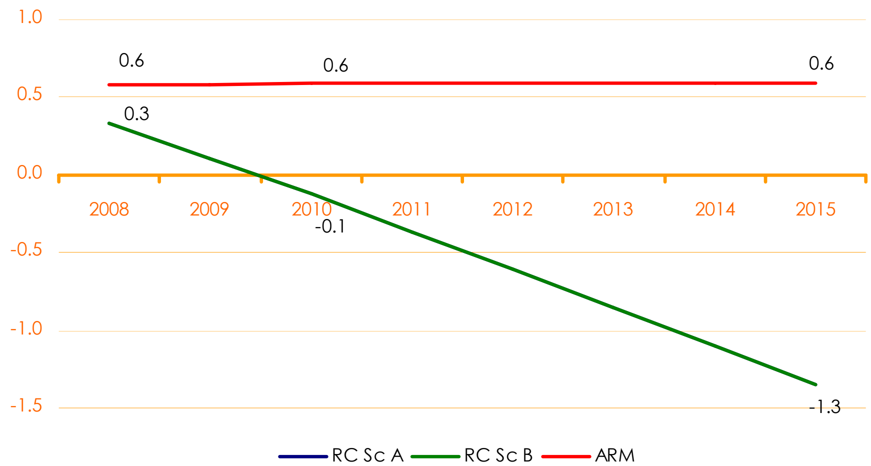
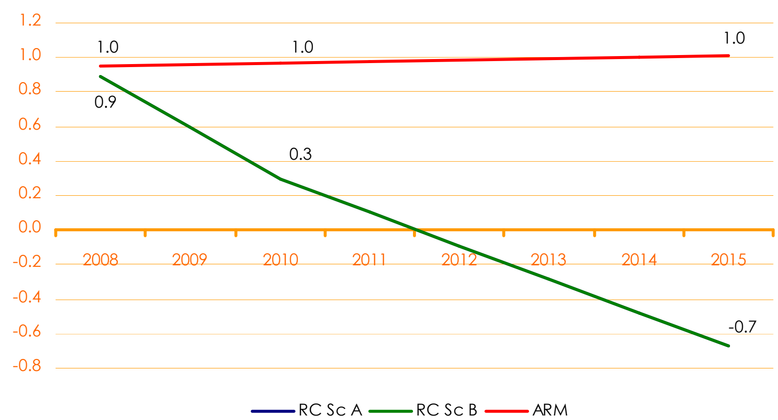


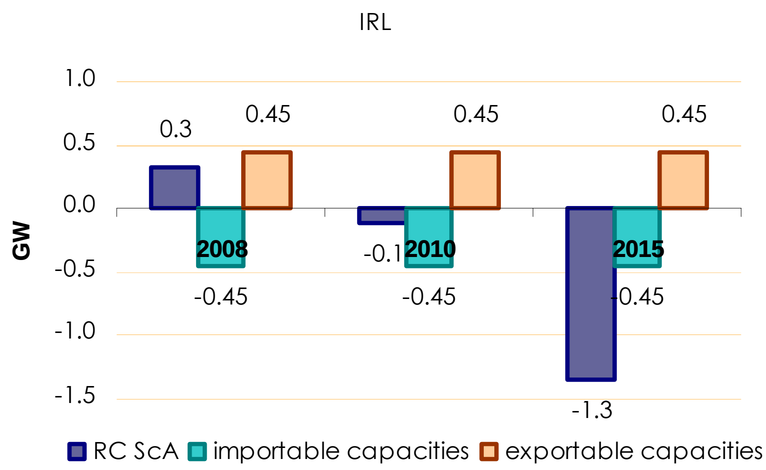
Figure 17	IRELAND – Remaining Capacity against Adequacy Reference Margin – Results in GW – July 11:00



Role of Interconnections:

Whilst there is an import capacity from GB (450MW) which can provide relief against the projected shortage of generating capacity, this may not however be relied upon as this could be offset by an equivalent export capacity with the Republic of Ireland. (330MW)

Figure 18	IRELAND – Remaining Capacity compared to Net Transfer Capacities – Results in GW - January 19:00



3.3.6 BALTIC COUNTRIES

Generation adequacy

The winter load growth can be estimated to 3.7% per year by 2010 (3.2% per year by 2015). Summer growth is expected to be 4.1% by 2010 (3.4% by 2015).

NGC is decreasing from 2008 to 2010: -2% in scenario A (-1% scenario B). By 2015 power plants commissioning will increase NGC by 1.1% (1.3% in scenario B).

In scenario A the adequacy feature is no longer met from 2009 on. The lack of available generation capacity reaches 1.2 GW in 2015.
Commissioning expected in scenario B cannot fulfil the ARM from 2010. Extra commissioning not already foreseen will be necessary.

Remaining Capacity vs. ARM

Figure 19	Baltic Countries – Remaining Capacity against Adequacy Reference Margin – Results in GW – January 19:00

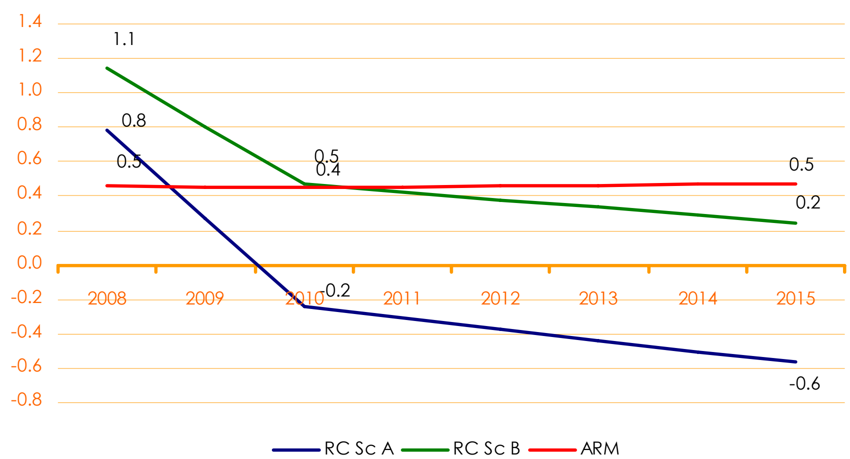
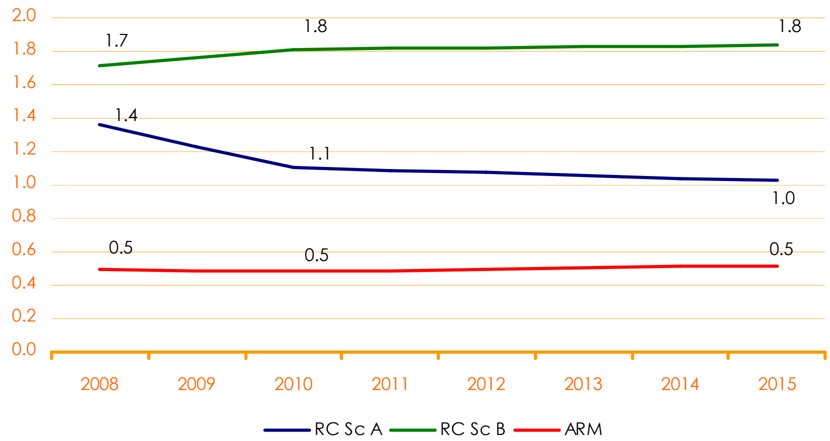


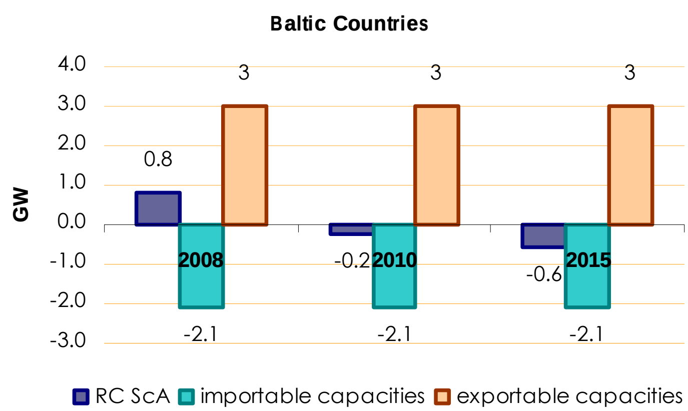
Figure 20	Baltic Countries – Remaining Capacity against Adequacy Reference Margin – Results in GW – July 11:00



Role of interconnections

Transfer capacities of the block seem to be sufficient to ensure the reliability over the period. Interconnections with Russia and NORDEL will allow covering tightened situations.

Fig 21	Baltic Countries – Remaining Capacity compared to Net Transfer Capacities – Results in GW January 19:00



3.3.7 SPAIN and PORTUGAL

Generation adequacy

From 2008 to 2010, the increase in generating capacity only relies on the development of renewable energy sources (thermal shutdown expected).

The Reliably Available Capacity decreases. Remaining Capacity is dropping.

ARM is not met neither in winter, nor in summer.

In 2015, new commissioning do not compensate expected shut down. Reliably Available Capacity is higher than in 2010, but **the increase of the load is yearly 3.2% for winter peak load, (3.4% in summer).**

Remaining Capacity could not meet ARM in 2015 and turns to zero for the block on July 11:00 reference time.

If Scenario B is considered, new commissioning not yet decided but somehow predictable would allow to improve the situation. Nevertheless, **these new projects are not sufficient to cover the adequacy for summer time**.

Remaining Capacity vs. ARM

Figure 22	Spain + Portugal – Remaining Capacity against Adequacy Reference Margin – Results in GW – January 19:00

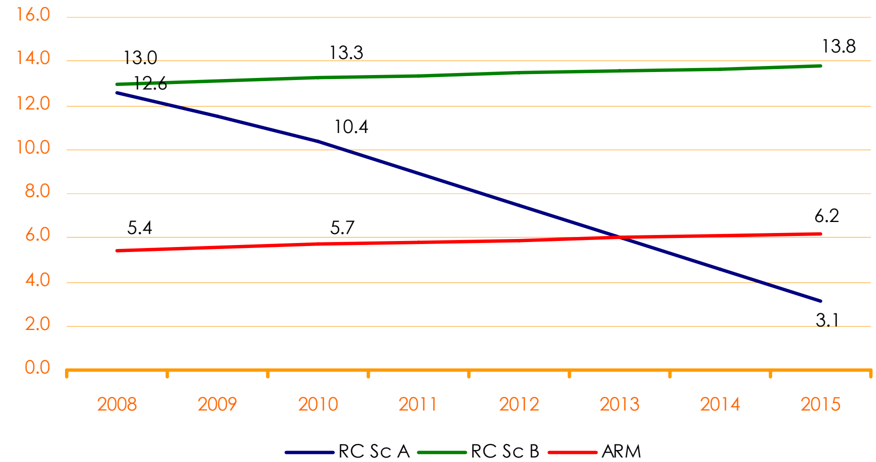
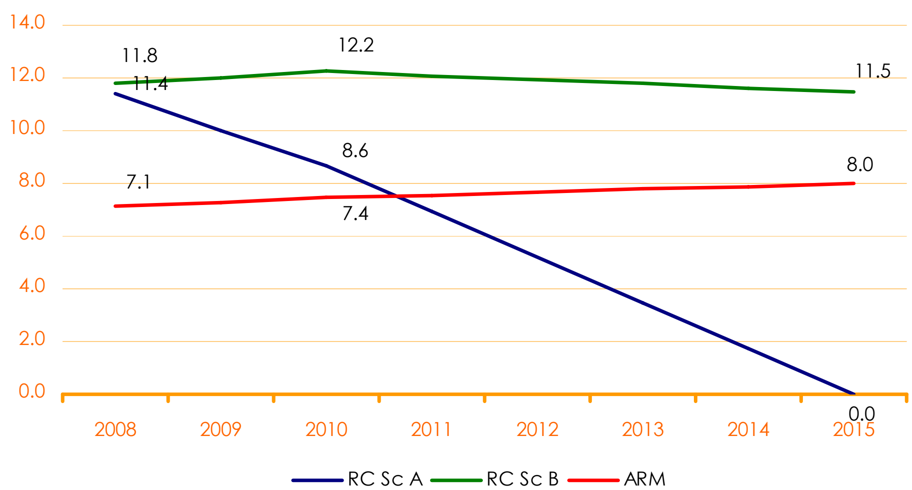


Figure 23	Spain + Portugal – Remaining Capacity against Adequacy Reference Margin – Results in GW – July 11:00



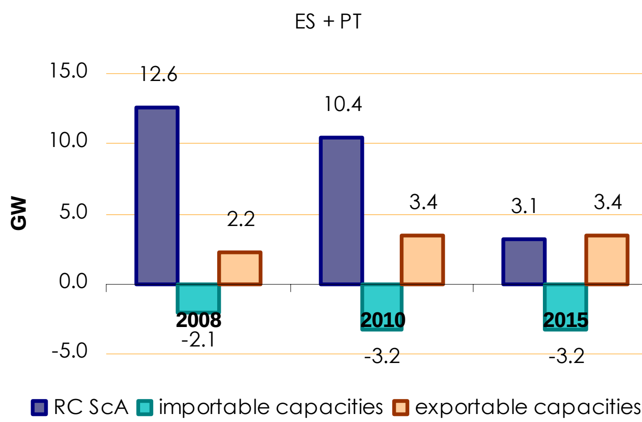
Role of interconnections

Interconnection capacity represents only a small part of the installed generation capacity (1.4 GW with UCTE main block).

In summer it is likely to be used for imports into Spain (considering the positive RC of UCTE main block).

In winter, balances of both systems (UCTE Main Block and Spain and Portugal) follow the same trend: positive Remaining Capacity at the beginning of the period, just balanced after 2010. Exchanges will depend on the conditions of each system.

Fig 24	Spain + Portugal – Remaining Capacity compared to Net Transfer Capacities – Results in GW - January 19:00



3.3.8 ITALY

Generation adequacy

The average growth rate from 2008 to 2010 is 4.1% per year and 2.1% by 2010 – 2015.

The generating capacity increases by 2 GW (+1 GW in Renewable power Stations). Thanks to commissioning of conventional power stations, and lower non-usable capacity, the Reliably Available Capacity grows by 4.5 GW. The increase in load is covered, and Remaining Capacity is quite stable from 2008 to 2010.

ARM is met in 2010, with an extra 6 GW margin in summer.

Some commissioning are expected over 2010-2015 period. About +0.6 GW of conventional thermal plants, +1 GW for renewable energy sources.

As a consequence, RC is dropping by 5 GW

The load increases by 2.2% in winter and 2.6% in summer reference time.

ARM is just met in summer 2015. +2GW capacities are brought by, if scenario B is considered.

Figure 25	Italy – Remaining Capacity against Adequacy Reference Margin – Results in GW – January 19:00

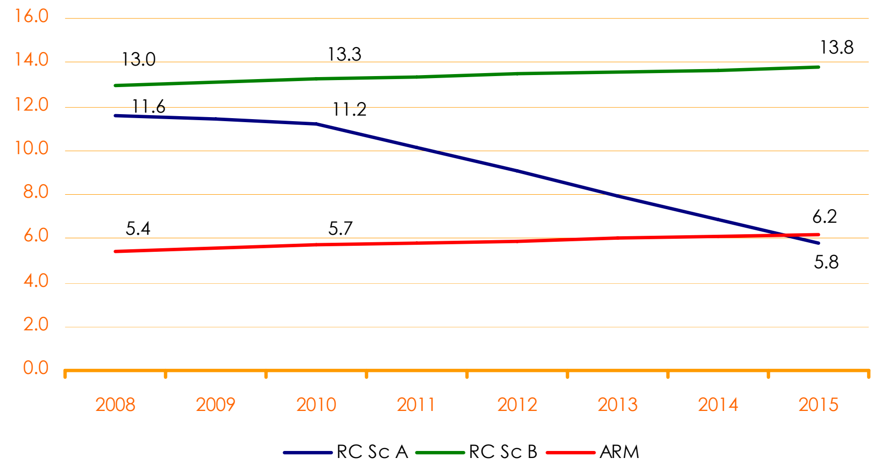
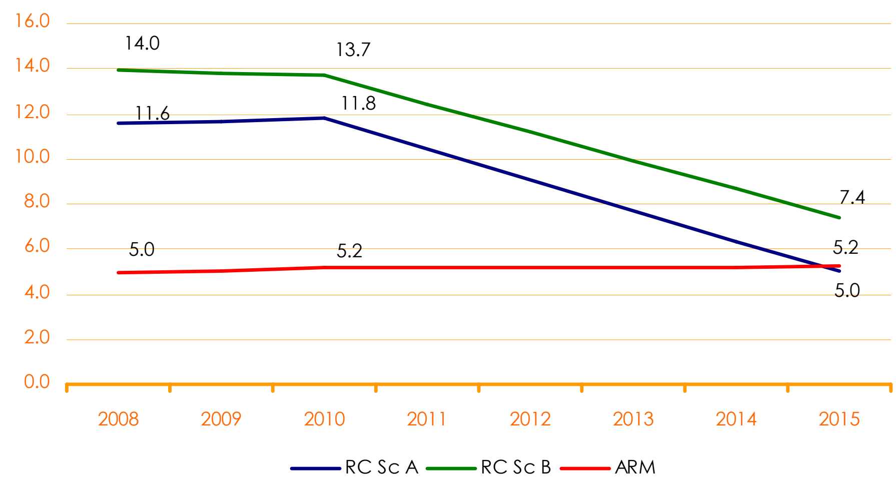


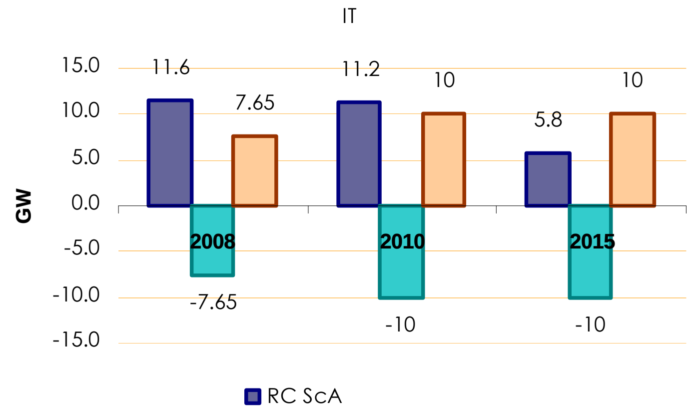
Figure 26	Italy – Remaining Capacity against Adequacy Reference Margin – Results in GW – July 11:00



Role of Interconnections

The expected import capacity (8 GW increasing to 9.5 GW) will provide additional security to the Italian system.

Figure 27	Italy – Remaining Capacity compared to Net Transfer Capacities – Results in GW January 19:00



3.3.9 SOUTH EASTERN UCTE

Generation Adequacy

The average growth rate is 3% by 2010 – 2015.

Generating Capacity developments (+2%) help to follow load increase, but do not fulfil the match to ARM. In July 2008, there is a lack of 3 GW The situation of the area will be weak if investments are not realised after 2008.

ARM is not met from 2008 to 2010.

ARM is not met in summer 2015; an extra Reliably Available Capacity of 6 GW is needed in summer (3 GW in winter).

If considering scenario B, adequacy is not respected over the period. The lack of power for scenario B is 4 GW in summer and 1 GW in winter.

Figure 28	South eastern UCTE – Remaining Capacity against Adequacy Reference Margin – Results in GW – January 19:00

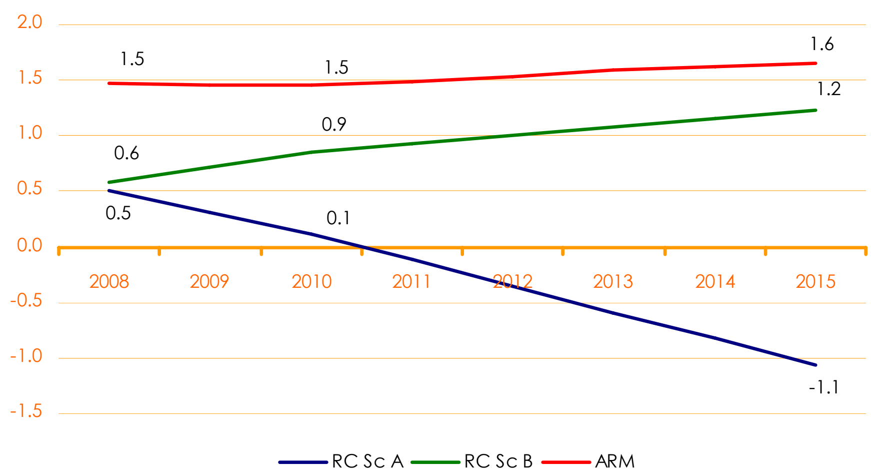
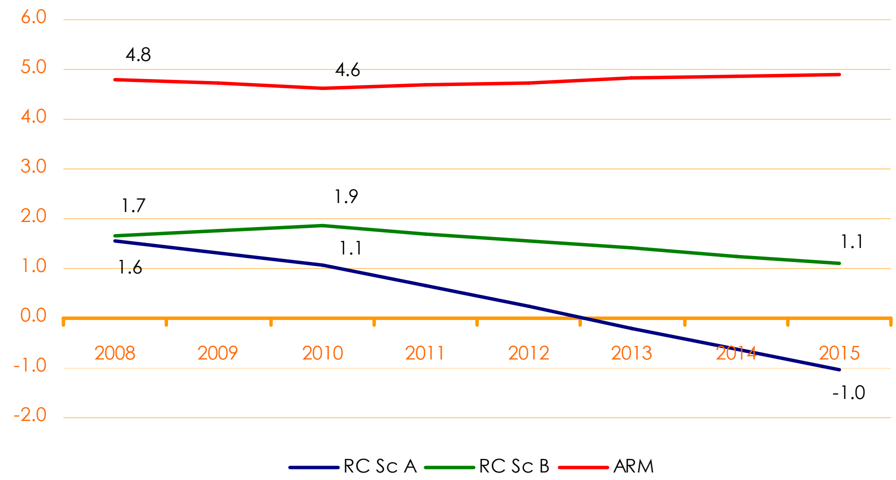


Figure 29	South eastern UCTE – Remaining Capacity against Adequacy Reference Margin – Results in GW – July 11:00



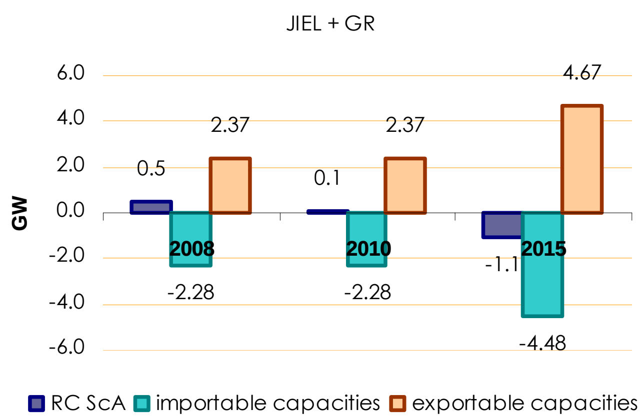
Role of interconnections

Interconnections will play a key role in ensuring security of supply from 2010 on.

Currently imports from Romania and Bulgaria, both of which have an export capability over 2008 – 2015 period. This will help to balance the situation in the region.

The interconnection of this zone with CENTREL and UCTE main block also increases the possibility of imports. Therefore, the use of interconnection capacity will probably relieve this system and its security will not be compromised.

Fig 30	South eastern UCTE – Remaining Capacity compared to Net Transfer Capacities – Results in GW January 19:00



3.3.10 ROMANIA and BULGARIA

Load growth rate is 2.8% in winter and 2.7% in summer from 2008 to 2010. Load keeps increasing by 1.9% in winter and 2.5% in summer by 2015.

From 2008 to 2010 generating capacity is expected to decrease by 0.4GW (fossil fuel power plants decommissioning). The remaining capacity decreases by 0.9GW.

Nevertheless, **ARM is met in winter 2010. For summer reference time, the situation is tightened; RC just meets the ARM.** Investments are necessary to improve the RC on summer 2010.

From 2010 to 2015 improving of nuclear power capacity in Bulgaria (+1GW) results in an increase of Reliably Available Capacity. Remaining Capacity is decreasing and **the ARM is not met in 2015.**

Extra-commissioning expected to be planned in scenario B can help to ensure the reliability of the block.

Remaining Capacity vs. ARM

Figure 31	Romania + Bulgaria – Remaining Capacity against Adequacy Reference Margin – Results in GW – January 19:00

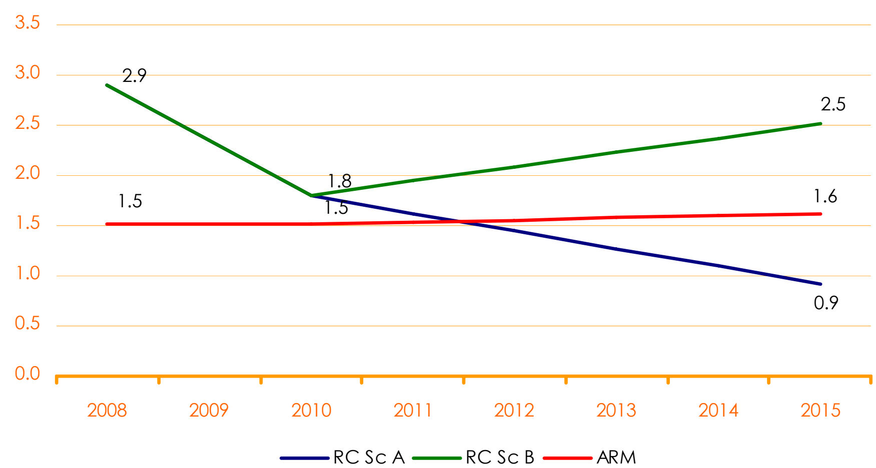
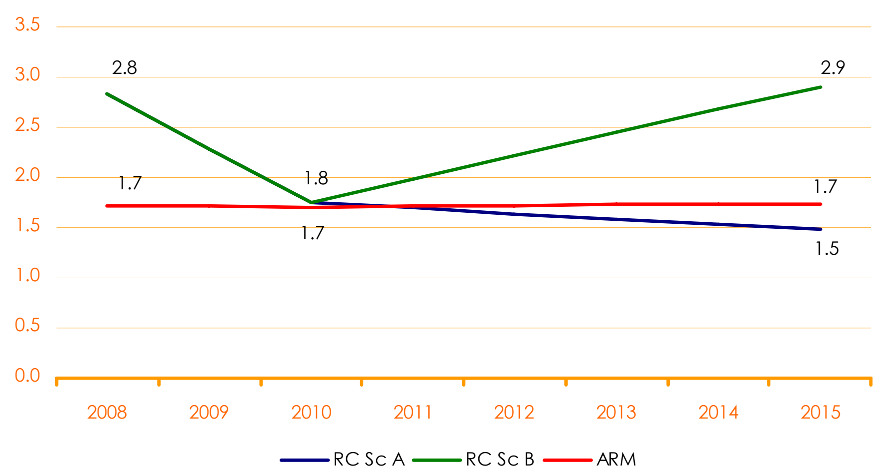


Figure 32	Romania + Bulgaria – Remaining Capacity against Adequacy Reference Margin – Results in GW – July 11:00

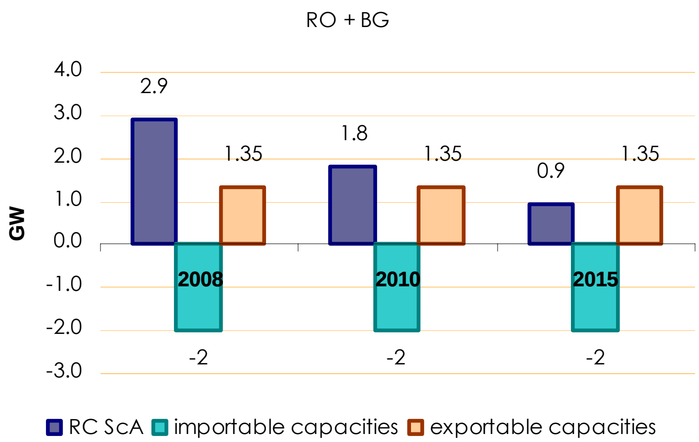


Role of interconnections

This block is connected with South Eastern UCTE and Centrel. Additional links exists with Turkey and IPS/UPS.

Interconnection with South Eastern UCTE will provide further security to this block especially in summer. Interconnection with Centrel can provide additional capacity.

Fig 33	Romania + Bulgaria – Remaining Capacity compared to Net Transfer Capacities – Results in GW January 19:00



4 BIBLIOGRAPHY

References used for this report:

1. UCTE SYSTEM ADEQUACY FORECAST 2006 – 2015 (www.ucte.org)
2. SEVEN YEAR STATEMENT 2005 (www.nationalgrid.com)
3. NORDEL Power and energy balances today and three years ahead (www.nordel.org)
4. IRELAND Generation adequacy statement 2006 – 2012 (www.eirgrid.ie.)

APPENDIX 1 – DETAILED RESULTS

Table 1	ETSO - European Generation Adequacy Forecast 2008 – 2015: global results (in GW)

		ETSO Jan. 19:00		ETSO **without NORDEL** July 11:00	
		Sc. A	Sc. B	Sc. A	Sc. B
NGC	2008	817.3	825.0	728.9	736.5
	2010	834.7	857.1	740.2	765.5
	2015	851.3	903.7	750.5	805.1
Reliably available capacity	2008	617.8	624.2	479.7	486.3
	2010	631.9	649.3	492.3	512.2
	2015	633.6	673.8	489.7	529.1
Load	2008	540.7	540.7	396.7	396.8
	2010	558.3	558.3	411.6	411.6
	2015	600.1	600.3	448.4	448.6
Remaining capacity	2008	77.1	83.5	82.9	89.5
	2010	73.7	91.0	80.8	100.6
	2015	33.6	73.5	41.3	80.5
margin against the daily peak load	2008	9.2	8.8	13.2	461.5
	2010	11.7	11.4	13.9	7.9
	2015	11.7	11.2	14.9	8.5

Table 2	**European Generation Adequacy Forecast 2008 – 2015: global results (in GW)** **January Forecast**

		NORDEL		IRL		GB		BALTIC COUNTRIES		MAIN_UCTE		SPAIN+Portugal		ITALY		SOUTH EASTERN UCTE		CENTREL		ROMANIA & BULGARIA	
		Sc. A	Sc. B	Sc. A	Sc. B	Sc. A	Sc. B	Sc. A	Sc. B	Sc. A	Sc. B	Sc. A	Sc. B	Sc. A	Sc. B	Sc. A	Sc. B	Sc. A	Sc. B	Sc. A	Sc. B
NGC	2008	92.4	92.7	9.8	9.8	75.7	77.1	9.5	7.0	325.8	328.2	89.5	89.9	96.6	99.2	23.4	23.5	67.4	67.6	27.3	27.3
	2010	99.2	99.2	9.9	9.9	75.3	77.0	10.1	7.7	331.0	342.1	93.3	96.2	98.3	100.8	24.4	25.6	67.4	69.8	26.9	26.9
	2015	99.4	101.5	9.8	9.8	74.3	76.0	9.1	7.4	335.8	362.4	98.5	109.9	100.1	102.6	26.4	29.0	69.5	72.9	28.1	29.7
Reliably available capacity	2008	72.7	72.8	7.2	7.2	65.8	67.2	6.1	4.3	242.5	244.1	65.1	65.5	69.9	72.1	18.6	18.7	52.9	53.1	17.4	17.4
	2010	77.4	77.4	7.2	7.2	65.4	67.1	6.5	4.9	245.0	253.6	66.0	68.9	74.4	76.2	19.4	20.2	54.9	55.7	17.2	17.2
	2015	77.6	78.3	7.0	7.0	64.4	66.1	5.5	4.6	239.9	257.8	67.8	78.4	75.8	77.6	21.4	23.7	55.9	58.7	18.2	19.8
Load	2008	69.0	69.0	6.8	6.8	62.0	62.0	4.9	3.3	212.1	212.1	52.6	52.6	58.3	58.3	18.1	18.1	42.5	42.5	14.5	14.5
	2010	70.5	70.5	7.3	7.3	63.0	63.0	5.2	3.5	217.2	217.2	55.7	55.7	63.2	63.2	19.3	19.3	41.3	41.3	15.4	15.4
	2015	74.3	74.3	8.4	8.4	64.8	64.8	5.9	4.0	226.9	227.1	64.6	64.6	70.0	70.0	22.4	22.4	45.1	45.1	17.3	17.3
Remaining capacity	2008	3.7	3.8	0.3	0.3	3.9	5.3	1.2	1.0	30.4	32.0	12.6	13.0	11.6	13.8	0.5	0.6	10.4	10.6	2.9	2.9
	2010	6.9	6.9	-0.1	-0.1	2.4	4.1	1.3	1.4	27.7	36.4	10.4	13.3	11.2	13.0	0.1	0.9	13.5	14.4	1.8	1.8
	2015	3.3	4.0	-1.3	-1.3	-0.5	1.2	-0.3	0.6	13.1	30.7	3.1	13.8	5.8	7.6	-1.1	1.2	10.8	13.6	0.9	2.5
margin against the daily peak load	2008	0.0	0.0	0.1	0.1	0.6	0.6	0.0	0.0	5.9	5.9	1.0	1.0	0.8	0.8	0.3	-0.1	0.4	0.4	0.2	0.2
	2010	0.0	0.0	0.1	0.1	0.6	0.6	0.0	0.0	5.7	5.7	1.0	1.0	0.8	0.8	0.2	-0.1	3.0	3.0	0.2	0.2
	2015	0.0	0.0	0.1	0.1	0.7	0.7	0.0	0.0	6.0	6.0	1.3	1.3	0.8	0.8	0.3	-0.2	2.3	2.3	0.2	0.2

Table 3	**European Generation Adequacy Forecast 2008 – 2015: global results (in GW)** **July Forecast**

		NORDEL		IRL		GB		BALTIC COUNTRIES		MAIN_UCTE		SPAIN+Portugal		ITALY		SOUTH EASTERN UCTE		CENTREL		ROMANIA & BULGARIA	
		Sc. A	Sc. B	Sc. A	Sc. B	Sc. A	Sc. B	Sc. A	Sc. B	Sc. A	Sc. B	Sc. A	Sc. B	Sc. A	Sc. B	Sc. A	Sc. B	Sc. A	Sc. B	Sc. A	Sc. B
NGC	2008	n.a.	n.a.	9.9	9.9	75.7	77.1	9.5	7.0	327.1	329.7	90.8	91.2	97.5	100.0	23.9	24.0	67.4	67.7	27.3	27.3
	2010	n.a.	n.a.	9.9	9.9	75.3	77.0	10.1	7.7	332.8	346.2	94.1	97.8	99.2	101.7	25.2	26.5	67.7	70.1	26.9	26.9
	2015	n.a.	n.a.	9.8	9.8	74.3	76.0	9.1	7.4	335.7	362.5	98.5	111.0	100.4	103.6	26.6	29.2	67.6	73.4	28.1	29.7
Reliably available capacity	2008	n.a.	n.a.	6.1	6.1	53.8	55.2	4.9	3.2	209.3	211.1	61.0	61.4	69.9	72.3	17.1	17.2	44.3	44.5	13.6	13.6
	2010	n.a.	n.a.	5.9	5.9	53.4	55.1	5.6	4.0	214.4	224.6	61.1	64.7	75.0	76.9	18.2	19.0	46.7	47.6	13.1	13.1
	2015	n.a.	n.a.	5.7	5.7	52.4	54.1	5.0	4.2	206.9	223.2	62.1	73.5	76.0	78.4	19.6	21.7	47.6	50.7	14.4	15.8
Load	2008	n.a.	n.a.	5.2	5.2	45.1	45.1	3.1	2.3	175.2	175.2	49.6	49.6	58.3	58.3	15.5	15.5	33.8	33.9	10.8	10.8
	2010	n.a.	n.a.	5.6	5.6	45.8	45.8	3.4	2.4	179.8	179.8	52.5	52.5	63.2	63.2	17.1	17.1	32.7	32.7	11.4	11.4
	2015	n.a.	n.a.	6.4	6.4	47.2	47.2	3.8	2.8	189.2	189.4	62.1	62.1	71.0	71.0	20.6	20.6	35.0	35.0	12.9	12.9
Remaining capacity	2008	n.a.	n.a.	0.9	0.9	8.8	10.2	1.8	0.9	34.1	35.9	11.4	11.8	11.6	14.0	1.6	1.7	10.4	10.6	2.8	2.8
	2010	n.a.	n.a.	0.3	0.3	7.6	9.3	2.2	1.6	34.6	44.8	8.6	12.2	11.8	13.7	1.1	1.9	13.9	14.9	1.7	1.8
	2015	n.a.	n.a.	-0.7	-0.7	5.2	6.9	1.1	1.4	17.7	33.8	0.0	11.5	5.0	7.4	-1.0	1.1	12.6	15.7	1.5	2.9
margin against the daily peak load	2008	n.a.	n.a.	0.5	0.5	0.5	0.5	0.0	0.0	5.1	5.4	2.6	2.6	0.1	0.1	3.6	-3.2	0.5	0.5	0.3	0.3
	2010	n.a.	n.a.	0.5	0.5	0.5	0.5	0.0	0.0	4.9	5.2	2.7	2.7	0.2	0.2	3.4	-2.9	1.4	1.4	0.4	0.4
	2015	n.a.	n.a.	0.5	0.5	0.5	0.5	0.0	0.0	5.3	5.6	3.0	3.0	0.2	0.2	3.6	-3.1	1.4	1.4	0.3	0.3

Table 4	Comparison between ETSO Generation Adequacy Forecast 2008 – 2015 with last year results – January 19:00

		ETSO		NORDEL		IRL		GB		Baltic Countries		Main UCTE		Spain + Portugal		Italy		South UCTE + GR		CENTREL		RO + BG	
		scA	**scB**	sc A	sc B	sc A	sc B	sc A	sc B	sc A	sc B	sc A	sc B	sc A	sc B	sc A	sc B	sc A	sc B	sc A	sc B	sc A	sc B
NGC	2010	**22.2**	**28.6**	4.0	1.0	0.6	0.6	0.6	0.3	8.9	9.4	-0.4	4.4	4.7	5.4	6.6	7.8	0.2	0.5	-1.8	0.5	-1.4	-1.4
	2015	**17.8**	**24.0**	3.0	0.2	0.3	0.3	-0.8	-2.4	9.5	10.0	-3.6	7.0	7.7	6.0	4.1	1.1	1.5	2.4	-0.4	1.3	-3.3	-1.7
RAC	2010	**23.0**	**26.1**	3.1	1.4	0.4	0.4	1.6	1.5	5.1	5.8	4.3	6.1	4.1	4.8	5.2	6.2	0.2	0.3	1.1	1.8	-2.0	-2.0
	2015	**23.6**	**24.3**	3.6	0.9	-0.1	-0.1	0.4	-0.8	5.7	6.5	3.4	8.8	6.8	5.2	2.8	-0.8	1.6	2.4	2.9	4.1	-3.5	-1.9
RL	2010	**0.0**	**0.0**	-2.4	-2.4	0.3	0.3	-0.4	-0.4	5.3	5.3	-1.5	-1.5	-0.2	-0.2	0.0	0.0	1.6	1.6	-1.4	-1.4	-1.3	-1.3
	2015	**4.0**	**4.4**	-1.5	-1.3	0.4	0.4	0.3	0.3	6.3	6.3	-0.1	0.1	0.0	0.0	-2.4	-2.4	2.6	2.6	-0.7	-0.7	-0.9	-0.9
RC	2010	**23.1**	**26.1**	5.5	3.8	0.1	0.1	2.0	1.9	-0.2	0.5	5.7	7.6	4.4	5.1	5.2	6.2	-1.4	-1.3	2.4	3.2	-0.7	-0.7
	2015	**19.7**	**19.9**	5.1	2.2	-0.4	-0.4	0.0	-1.2	-0.6	0.2	3.6	8.7	6.7	5.2	5.2	1.6	-1.1	-0.3	3.6	4.8	-2.6	-1.0

Figure 33	ETSO – Transmission system adequacy – January 19:00 - 2008

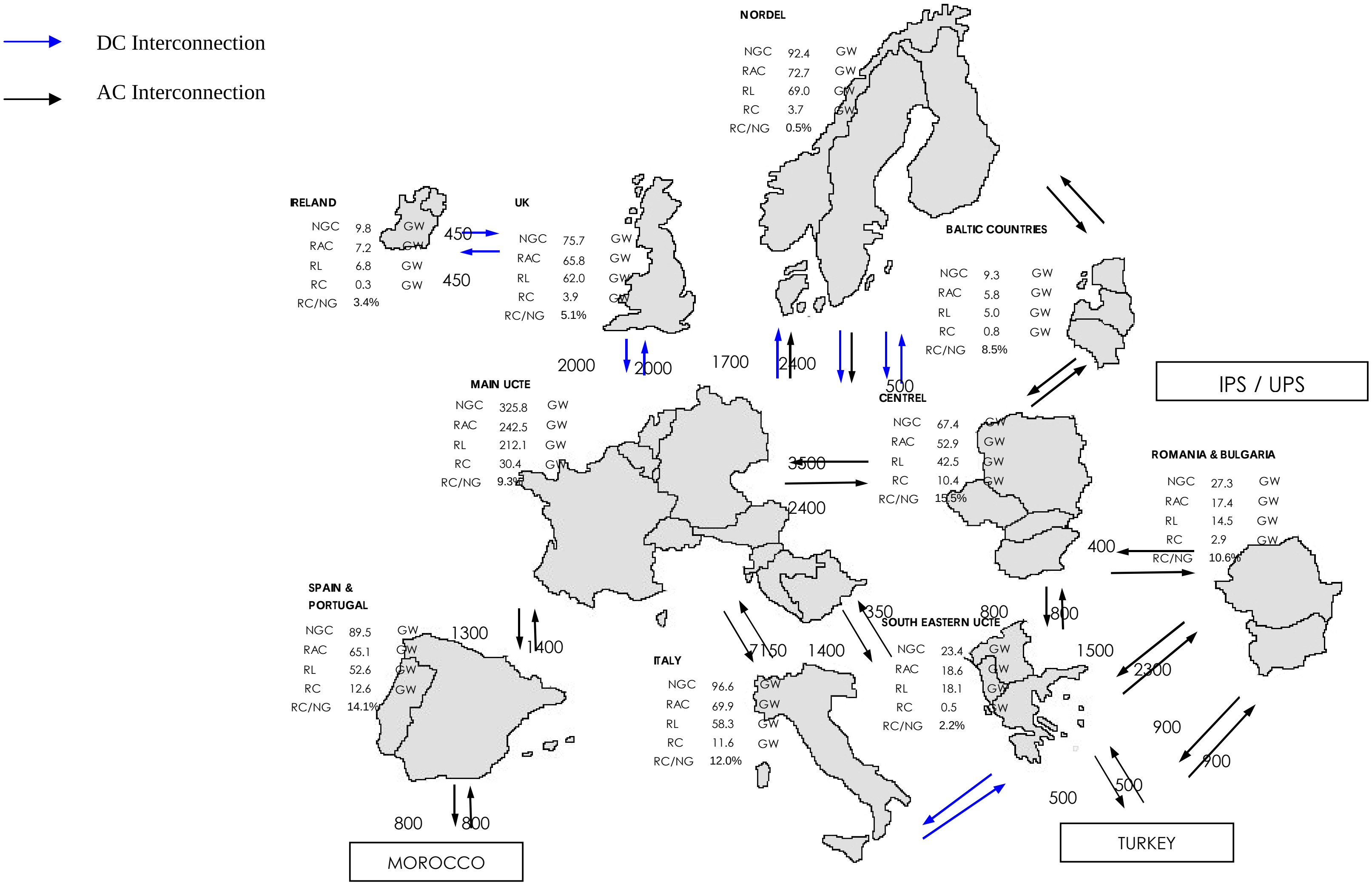


Figure 34	ETSO – Transmission system adequacy – January 19:00 - 2010

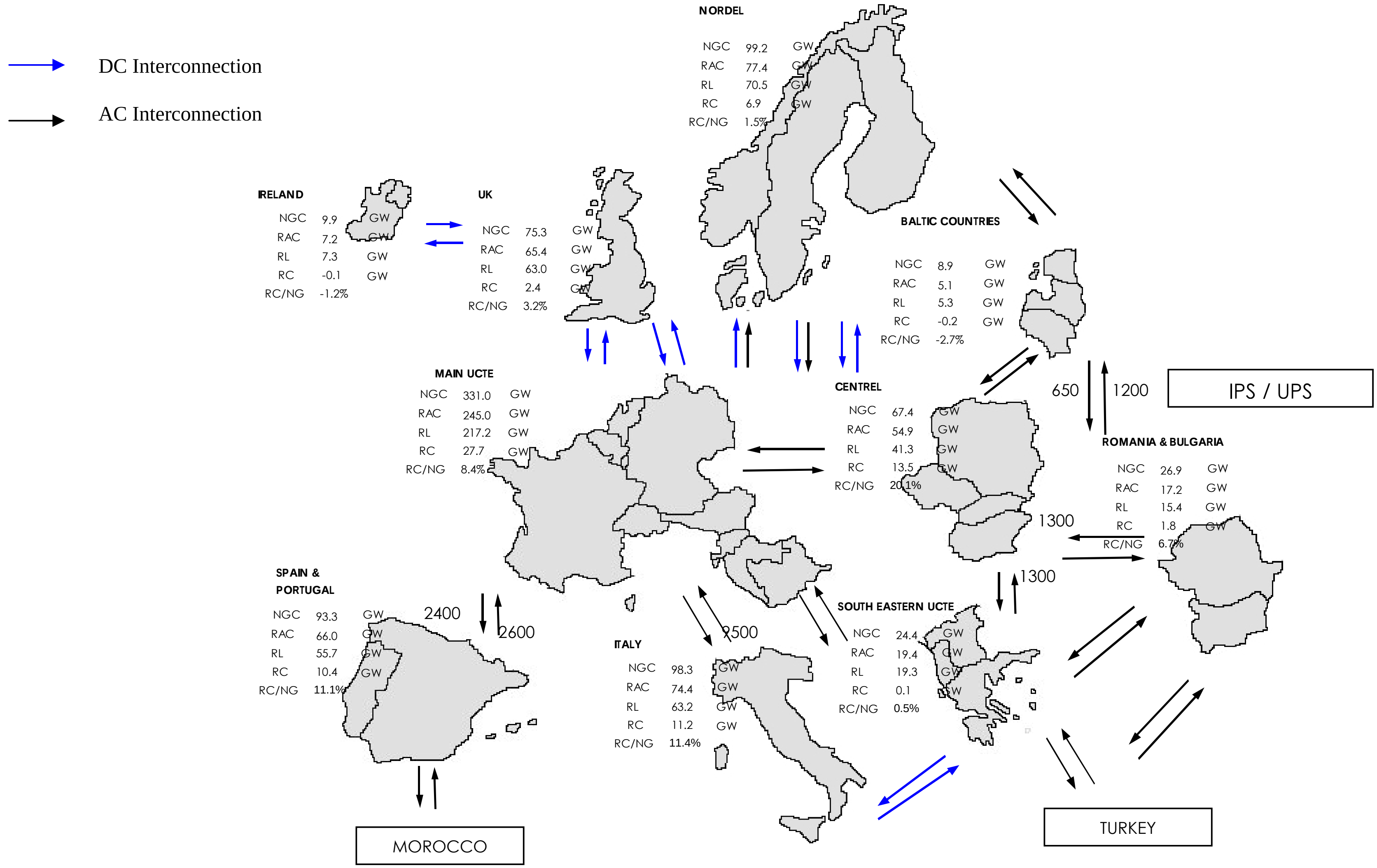
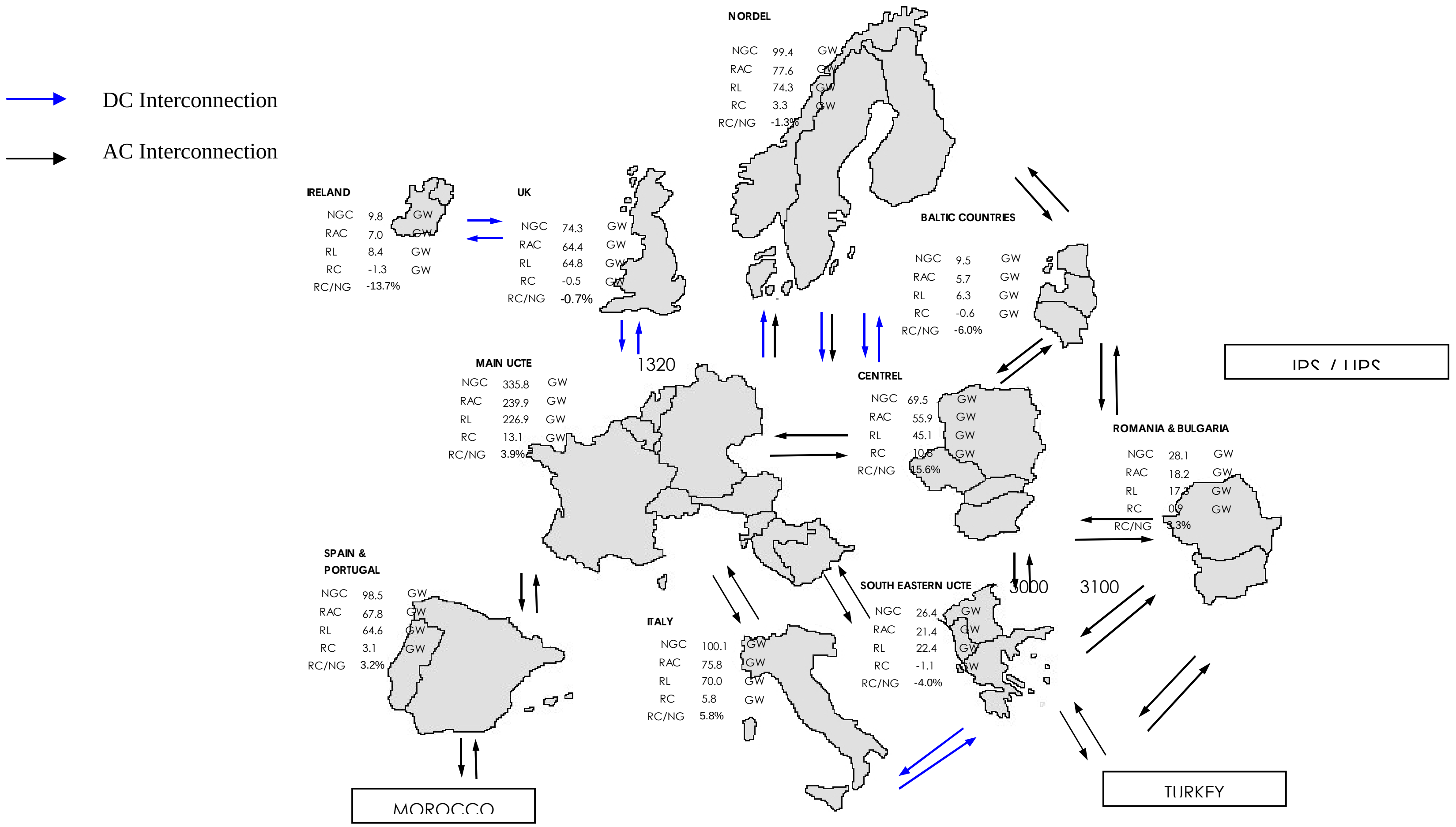


Figure 35	**ETSO – Transmission system adequacy – January 19:00 - 2015**



APPENDIX 2 – STRUCTURE OF THE POWER BALANCE

The power balance forecasts are based on the following items:

Net Generating Capacity (NGC)

The net generating power capacity is the sum of the net maximum output of all power stations.

Reliably Available Capacity (RAC)

RAC corresponds to the national generating power capacity after deducting non-usable capacity, estimated (planned) overhauls and (forced) outages of thermal power stations as well as system services reserves; this is in fact the estimated available capacity in average operating conditions in peak hours.

Based on available production statistics, the TSO have estimated the part of the generating capacity which is not usable due to the above various reasons:

- **non-usable capacity** may be due to lack of primary energy (for example wind energy), temporary limitations of capacity in hydroelectric power stations and multi-purpose installations (for example heat extraction in combined heat and power plants, water debit for irrigation), capacity of power stations in test operation whose commissioning date is uncertain, limitations due to transmission network congestion etc. Mothballed plant which can be returned to service within a short time (from some months to one year or even longer) should be also deducted from the NGC; however in some cases the capacity of these mothballed plants is already deducted from the NGC.

- In respect of **outages**, a statistical average value (expected value) is used in the forecast.

System services refer to capacities, which are managed by the TSOs to ensure the short-term operation of the power system. They include operational reserves needed for frequency control, voltage control, disturbances in the power stations or in the grid, restoration of supply and system management. System services reserves do not include lreserve capacities, which are within the responsibility of the power producers in the market. The latter long-term reserves are included in the Remaining Capacity (see below).

Reference Load (RL)

In order to get a consistent picture of the power balance across Europe it has been decided to collate load data against a common reference time. The load of each country (including transmission losses) is recorded for the 3rd Wednesday in January at 19:00 and 3rd Wednesday of July at 11:00 (this latter not available for NORDEL), without taking into account power exports. The projections of load are made under normal climatic conditions, e.g. outdoor temperatures corresponding to the statistical average, and normal development of economic activities are assumed in these forecasts.

Basing the power balance on such a common time seems to be preferable to basing it on each TSO´s peak load ; due to the large geographical scale of the European system the regional peaks occur at different times and their summation would systematically over-estimates the common peak load of the larger system. NORDEL load figures correspond the estimated synchronous peak demand of the whole region.

Margin to Peak Load (MPL)

When interpreting the load forecast and generation adequacy results, one needs to consider that the reference time may not correspond to the maximum peak load recorded in the different control areas.

To help quantify this effect, the difference between the demand at the reference time and the peak demand is provided as additional information. Calculating the remaining capacity at the peak gives a more reliable estimation of the generation adequacy for the isolated systems of some regions. The January load figures are estimated peak loads as well.

Because the peak load for a set of countries like Nordel is calculated as the sum of the peaks of the individual countries, this leads to an overestimate of the peak load for the largest geographical blocks (or subsystems).

Remaining Capacity at Reference Load (RCRL)

The remaining capacity at the reference load is obtained from the expected available capacity minus the reference load. As explained, the reference load does not represent the peak load. This is an additional reason why the remaining capacity must not be interpreted as a surplus capacity.

Remaining Capacity at Peak Load (RCPL)

The remaining capacity at the peak load is obtained from the remaining capacity against reference load minus the margin to peak load. The remaining capacity at time of peak load provides a better indication of the adequacy of generation to meet load against a number of potential risks of loss of plant, abnormal weather and demand forecast errors. It also provides a more realistic estimate of the potential for exports. ;

Transfer Capacities

In this study no forecasts for the transfers between different control areas or countries have been made. However, the potential effect of such transfers on the reliability of supply within each sub-system can be inferred from the net transfer capacities (NTCs) between the sub-systems. These NTC values are calculated at regular intervals by ETSO (www.etso-net.org).

END OF THE DOCUMENT