ENTSO-E Report
System Adequacy Forecast 2010 – 2025

Table of Content:

General Introduction

About ENTSO-E

ENTSO-E is a pan-European association covering 42 members - 42 TSOs from 34 countries. It is an association which continues to successfully help co-ordinate TSO work following its 6 predecessor associations[1]. Within ENTSO-E, the different committees, working groups and task forces have transferred their work into the new ENTSO-E structure where the well established work will continue, but will also be enhanced through the new pan-European perspective of ENTSO-E.

The ENTSO-E association has been established in line with the EU legislation (Third liberalisation energy package). More precisely the ground for establishing ENTSO-E is Regulation (EC) No 714/2009 on conditions for access to the network for cross-border exchanges in electricity (this regulation cancels the Regulation (EC) No 1228/2003).

According to the above mentioned legislation document the main purpose of ENTSO-E is

- to pursue the co-operation of the European TSOs both on the pan-European and regional level;
- to promote the TSOs' interests; and
- to have an active and important role in the European rule setting process in compliance with EU legislation.

The main objective of ENTSO-E is to promote the reliable operation, optimal management and sound technical evolution of the European electricity transmission system in order to ensure security of supply and to meet the needs of the Internal Energy Market.

ENTSO-E activities include:

- Coordination of the development of an economic, secure and environmentally sustainable transmission system. The emphasis lies in the coordination of cross border investments and meeting the European security and quality of supply requirements, while the implementation of investments lies with the TSOs;
- Development of technical codes for the interoperability and coordination of system operation in order to maintain the reliability of the power system and to use the existing resources efficiently;
- Development of network related market codes in order to ensure non-discriminatory access to the grid and to facilitate consistent European electricity market integration;
- Monitoring and, where applicable, enforcing the compliance of the implementation of the codes;
- Monitoring network development, promotion of R&D activities relevant for the TSO industry and promotion of public acceptability of transmission infrastructure;
- Taking positions on issues that can have an impact on the development and operation of the transmission system or market facilitation;
- Enhancing communication and consultation with stakeholders and transparency of TSO operations.

---

[1] ***ATSOI*** *(Association of the Transmission System Operators of Ireland);* ***BALTSO*** *(Baltic Transmission System Operators);* ***ETSO*** *(European Transmission System Operators);* ***NORDEL*** *(Association of TSOs from Norway, Finland, Denmark and Sweden);* ***UCTE*** *(Union for the Coordination of the Transmission of Electricity);* ***UKTSOA*** *(UK Transmission System Operators Association)*

EU “3x20 targets” and ENTSO-E

The EU's climate and energy policy sets the following ambitious targets for 2020:

- Cutting greenhouse gases by at least 20% of 1990 levels;
- Increasing use of renewable energy sources (wind, solar, biomass, etc) to 20% of total energy consumption (currently ± 8.5%);
- Increasing energy efficiency by 20%.

The construction of a load and generation scenario for electricity for each country that is compliant with the 3x20 targets is a required input for grid studies that will allow the identification of potential grid investment to facilitate and/or allow the realisation of the 3x20 targets. The ENTSO-E Working Group Ten Year Network Development Plan has launched therefore a questionnaire that should make it possible for ENTSO-E to report in the first Ten Year Network Development Plan (TYNDP) about the potential difficulties to specify the impact of the 3x20 targets on the electricity sector and thus plan the necessary grid developments required by the 3x20 policies throughout Europe.

Based on the survey it can be concluded that at time of publication, only in nine of the 34 countries (42 TSOs) represented in ENTSO-E have released their official targets how to achieve the 3x20 goals. Consequently, today no ENTSO-E pan-European 3x20 target scenario can be constructed. However some countries already take into account national policies when constructing scenarios for the System Adequacy Forecast Report (see national comments for more information).

As each Member State must submit a National Renewable Energy Action Plan (NREAP) to the Commission by 30 June 2010 at the latest, it can be assumed that for the next System Adequacy Forecast Report issue all EU countries will have national official targets.

In appendix (Chapter 8) is the calculation of preliminary CO_2 and RES generation indicators based on currently collected SAF data.

1. Executive summary

This ENTSO-E System Adequacy Forecast Report (hereinafter only “SAF Report”), for the time period 2010-2025, has been developed as the successor to the former UCTE System Adequacy Forecast Report and ETSO Power System Adequacy Report.

This report assesses adequacy of the ENTSO-E TSO member’s power system for the period 2010 - 2025 by providing an overview of:

- Generation Adequacy Analysis for whole ENTSO-E;
- Generation Adequacy Assessment for each individual country based on national comments received from TSOs (national data correspondents);
- Role of the transmission capacities in security of supply on a regional basis (could load that is not covered by local generation be met by imports of electricity).

The assessment has primarily been carried out using input data provided by each country for the years 2010, 2015, 2016, 2020 and 2025; other years and time horizons are calculated as linear extrapolation and are to be considered only as best estimates. The year 2016 has been introduced in order to assess the consequences on the generation adequacy of the decommissioning of the oldest thermal plants by the end of 2015 at the latest as the consequence of entry into force of the directive on Large Combustion Plant Directive.

The adequacy analysis is carried over two scenarios covering generating capacity evolution (Conservative Scenario A and Best Estimate Scenario B; for more information see paragraph 2.2 Definitions) and is based on the comparison between available generation and load at given three reference time points of the year (3rd Wednesday in January at 11 a.m. and at 7 p.m., 3rd Wednesday in July at 11 a.m.) over the time period 2010 - 2025.

More precisely, in order to assess adequacy, “Remaining Capacity” is compared to a given “Adequacy Reference Margin” (ARM) accounting for unexpected events affecting load and generation. The ARM is calculated for each country and for overall ENTSO-E. It is a parameter which serves as an instrument to cover the increase of load from the reference time point to the peak load (called “margin against peak load”), and demand variations or longer term generation outages not covered by operational reserves.

In the load and consumption forecasts, most TSOs consider the influence of the economic crisis. All provided values are connected to the Gross National Product (GNP) and could change according to the rate of economic recovery/development in the future.

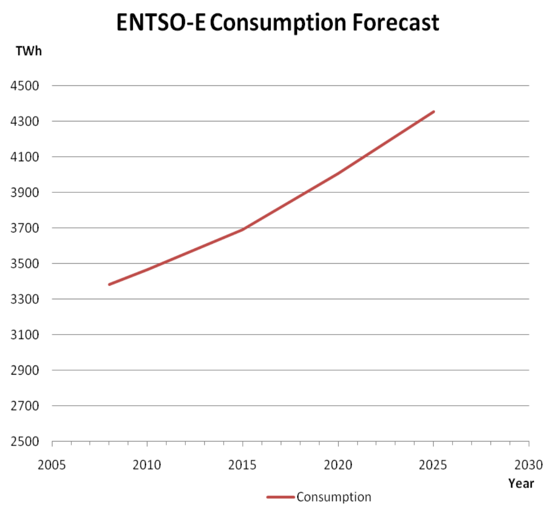


Figure 1.1: ENTSO-E Consumption Forecast

During whole monitored time period there is visible load growth. The energy consumption growth for the period between 2010 and 2015 may be assessed as “too optimistic” because of the financial and economic crisis (although all TSOs/national data correspondents reflect its impact)[2]. ENTSO-E consumption is expected to be 3690 TWh in 2015 and 4004 TWh in 2020.

Net Generating Capacity is till 2015 increasing in both of scenarios, with a small exception in Scenario A; after 2015 there is small decrease (-3 GW) but from 2016 it starts to increase again, although quite slowly. This small decrease is visible also in Scenario B when NGC annual average increase is not as rapid (0.38%) as in previous (3.43%) and following (1.79%) time periods. In Scenario A there is expected in 2020 about 1007 GW in NGC and in Scenario B it is about 1163 GW. After this term in 2025 the values are 1010 GW in Scenario A and 1238 GW in Scenario B. These values (in 2025) however are influenced by quite high uncertainty of data provided by TSOs/national data correspondents caused by its availability/unavailability to the respective TSO. Another reason could be that lot of different national policies and important documents, which are in many cases a necessary basis for TSOs´ considerations, do not cover such a long-term period.

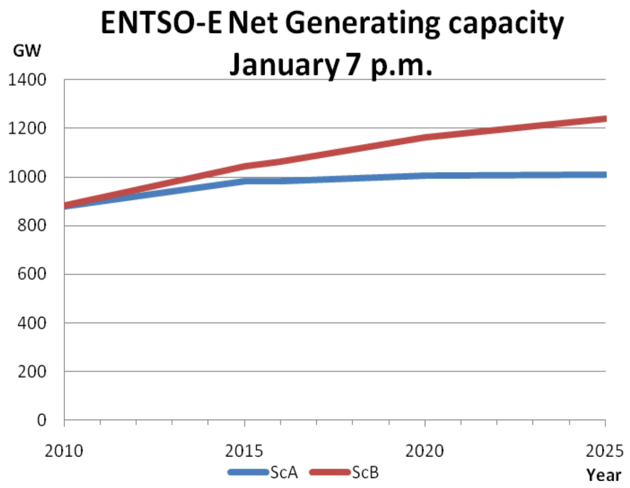


Figure 1.2: ENTSO-E Net Generating Capacity Forecast

Large Combustion Plant Directive[3,4] (thereinafter as “LCP Directive”) applies to combustion plants with a rated thermal input equal to or greater than 50 MW. The fuel used in those units is not determining criterion. LCP Directive applies only to European Union (EU) member states. Therefore ENTSO-E member countries outside of EU perimeter are not obliged to follow its goals. Due to this directive there is probably a visible decrease of installed capacity in fossil fuels after 2015 in both scenarios. In Scenario A the decrease in 2016 is about 3% (14.63 GW) compared to 2015 and in Scenario B it is only 0.19% (1 GW) compared to the same year. In Scenario A the decrease continues (about 22 GW up to the year 2025) and in Scenario B after 2016 there is a visible increase about 27 GW up to the 2020.

On the other hand the share of gas power plants in total fossil fuels installed capacity is significant and it illustrates the preference for gas among potential investors. There could be more reasons for such behaviour of investors:

---

[2] *For more information see paragraph 3.1*

[3] *Directive 2001/80/EC of the European parliament and of the Council of 23 October 2001on the limitation of emissions of certain pollutants into the air from large combustion plants*

[4] *The Commission adopted on 21 December 2007 a Proposal for a Directive on industrial emissions. The Proposal recasts seven existing Directives (including the IPPC Directive, the Large Combustion Plants Directive, the Waste Incineration Directive, the Solvents Emissions Directive and 3 Directives on Titanium Dioxide the IPPC) into a single clear and coherent legislative instrument.*

- lower investment costs and a higher flexibility compared to other types of thermal units, which is in many countries also related to a motivation to participate in ancillary services markets;
- existing climate change policies (favouring gas as a lower CO_2 producer than coal power plants)

This trend could potentially increase Europe´s dependency on gas supply, because gas has to be imported (more or less) into the all of ENTSO-E countries. Thus, security of supply from electrical point of view is getting more and more dependent on the supply, transport and storage capacities for gas (for more information see also the latest ENTSO-E Winter Outlook Report[5]).

Gas power plant installed capacity is in Scenario A after 2015 almost stable (from 193.6 GW in 2015 up to 200.7 GW in 2025) whereas in Scenario B that increase is more rapid (from 214.6 GW in 2015 up to 253 GW in 2025).

This increase in installed capacity of gas power plants is also connected with the higher development of Renewable Energy Sources (thereinafter only "RES"; not considering hydro power plants) in Scenario B than in Scenario A although the continuous increase is visible in both of them. In Scenario A the annual average growth in RES (excluding hydro)[6] is 6.02% per year (total increase about 140 GW up to 2025) and in Scenario B it is 7.95% per year (total increase about 218 GW). This increasing course of RES capacity (excluding hydro) is visible in each reference point. The main contributors between 2010 and 2025 are Germany (45.8 GW), Spain (39.9 GW), France (26.8 GW), Italy and Great Britain (both about 17.5 GW).

The evolution of RES installed capacity (excluding hydro) corresponds mainly with increasing wind farms development. It is influenced mainly by the EU politics and thereafter also by individual policy in each country. EU and its member states, as well as lot of non-member states, adopt different legislative measures how to contribute to the living environment protection and sustainable living. This area is tightly connected with EU 3x20 targets adopted under climate-energy legislative package[7].

Remaining capacity (thereinafter "RC") in ENTSO-E is positive in each reference point and in both scenarios. Only in Scenario A, in January 2025 (reference point 7 p.m.), RC value is expected to be quite low (+1.7 GW). This time horizon is quite far from present and is influenced by high uncertainty concerning assumptions made by each TSO/national data correspondent. It is caused by a more pessimistic view on new generation development in this Scenario.

---

[5] http://www.entsoe.eu/index.php?id=50

[6] *There is no clear definition in the data collection process between pump storage power plants (which are not defined/considered in SAF Report as RES) and other hydro power plants (defined/considered in SAF Report as RES). Hydro power plants are therefore excluded from the figures in SAF Report dealing with renewables. For more detailed information regarding RES definition see paragraph 3.2.4.*

[7] http://ec.europa.eu/environment/climat/climate_action.htm

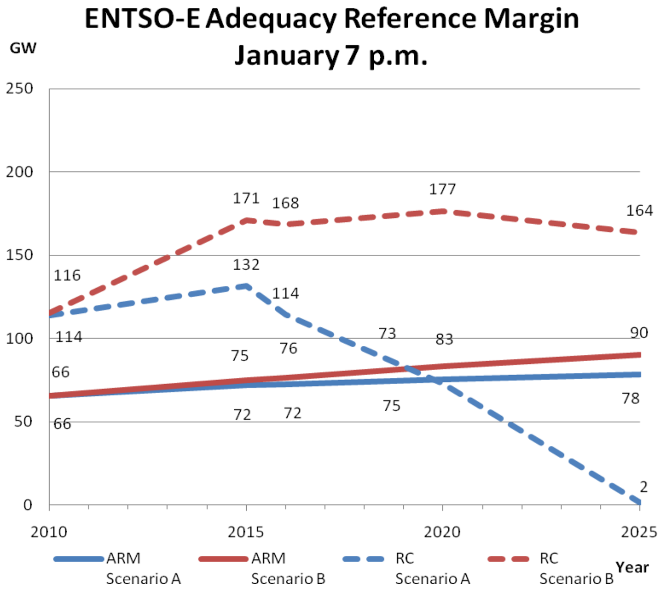


Figure 1.3: ENTSO-E Adequacy Reference Margin and Remaining Capacity comparison

Generation adequacy in Scenario B should be maintained during all monitored periods (in each reference point without considering possible transport capacity limitations between countries and/or regions). In Scenario A generation adequacy should be maintained until 2020. After this term new generation capacity could be needed to achieve at least today's levels of adequacy. In 2025 (reference point January 7 p.m.) about 124 GW in RAC will be needed, which makes about 193 GW of new generation capacity. In Scenario B generation adequacy is maintained all the time in any reference point as well. In January 2025 at 7 p.m., RC is about 24 GW higher than ARM today, i.e. there is surplus of generation capacity of approximately 37.4 GW[8].

[8] *For more details refer to Chapters 3.2.6 and 3.3.2*

2. Introduction

This chapter is dedicated to the aims, main definitions and to the brief methodology (including assessment description) which was used within the processing of this SAF Report. As this is the first such report under the ENTSO-E organisation it is based on two rather different methodologies and approaches undertaken by the two previous associations UCTE and ETSO. In the future reports, the extent and scope of the SAF Report will undergo some changes.

For more detailed information and definitions from previous ETSO and UCTE system adequacy reports please follow next links:

- http://www.entsoe.eu/index.php?id=84
- http://www.entsoe.eu/index.php?id=58

2.1 Aims and perimeters

This report assesses the adequacy of the ENTSO-E power system for the period 2010 - 2025 by providing an overview of:

- Generation Adequacy Analysis for whole of ENTSO-E;
- Generation Adequacy Assessment for each individual country/control area based on national comments received from TSOs/national data correspondents;
- Role of the transmission capacities in security of supply on a regional basis (could load that is not covered by local generation be met by imports of electricity).

In this report, analyses are made for the following countries/control areas grouped in the regions set by ENTSO-E for all system development purposes:

NORTH SEA: Belgium (BE), Denmark (DK), France (FR), Germany (DE), Great Britain (GB), Luxembourg (LU), the Netherlands (NL), Northern Ireland (NI), Norway (NO) and the Republic of Ireland (IE)

BALTIC SEA: Denmark (DK), Estonia (EE), Finland (FI), Germany (DE), Latvia (LV), Lithuania (LT), Norway (NO), Poland (PL) and Sweden (SE).

CONTINENTAL SOUTH WEST: France (FR), Portugal (PT) and Spain (ES).

CONTINENTAL SOUTH EAST: Bosnia-Herzegovina (BA), Bulgaria (BG), Croatia (HR), Former Yugoslav Republic of Macedonia (MK), Greece (GR), Hungary (HU), Italy (IT), Montenegro (ME), Republic of Serbia (RS), Romania (RO) and Slovenia (SI).

CONTINENTAL CENTRE SOUTH: Austria (AT), France (FR), Germany (DE), Italy (IT), Slovenia (SI) and Switzerland (CH);

CONTINENTAL CENTRE EAST: Austria (AT), Croatia (HR), Czech Republic (CZ), Germany (DE), Hungary (HU), Poland (PL), Romania (RO), Slovak Republic (SK) and Slovenia (SI).

In addition to these regions and countries listed above, analyses are reported on some other countries/control areas:

ISOLATED SYSTEMS: Cyprus (CY), Iceland (IS)

ADDITIONAL CONTRIBUTING CONTROL AREAS: Ukraine West (UA-W)

All above mentioned regions are depicted on the figure below.

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

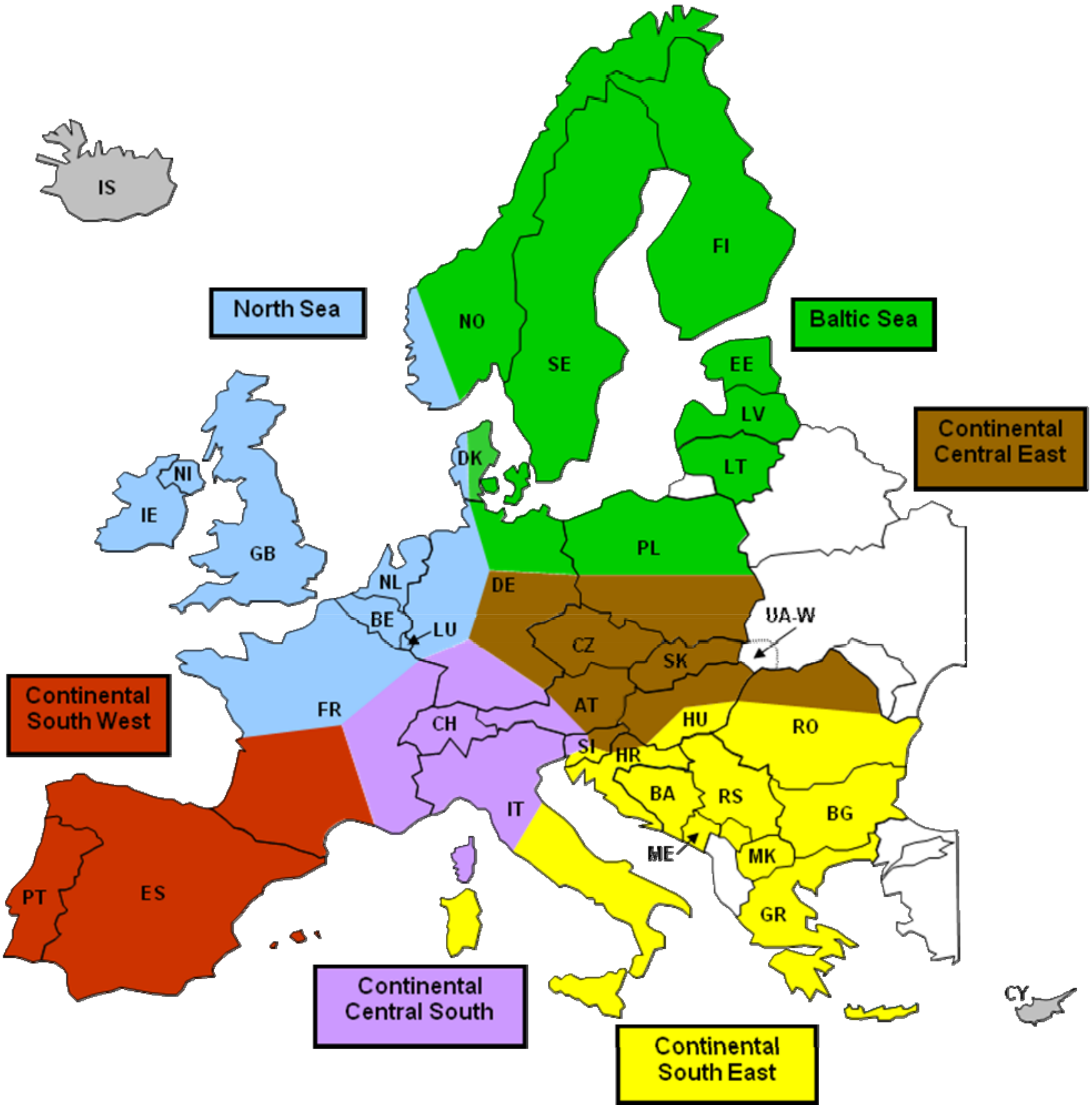


Figure 2.1: Map displaying ENTSO-E regions

2.2 Definitions

Scenario A/Scenario B

With respect to generation, two long-term generation scenarios were developed to help assess the range of uncertainty and evaluate the risk to the security of supply over the coming years. Generation data provided for each country thus follow these two generation scenarios:

► ***Conservative Scenario or Scenario A***

This scenario takes into account the commissioning of new power plants considered as certain and the shutdown of power plants expected during the study period.

It shows the evolution of the potential imbalances if no new investment decisions were to be taken in the future and allows the identification of the investments necessary to maintain the expected security of supply over the forecast period.

► ***Best Estimate Scenario or Scenario B***

This scenario takes into account the generation capacity evolution described in scenario A as well as future power plants whose commissioning can be considered as reasonably credible according to the information available to the TSOs.

This gives an estimation of potential future developments, provided that market signals give adequate incentives for investments, and may include extensions to operating lifetimes of existing generation plants.

The main sources of information are the national policies. Therefore, the forecast scenarios are built on a national basis (and often discussed on a national basis with the governmental or administrative bodies) and then aggregated at the sub-regional or regional level. Such a bottom-up approach is the easiest way for national stakeholders to agree with the national forecast scenario.

Load

Load on a power system is the net (excluding consumption of power plants´ auxiliaries, but including network losses) consumption corresponding to the hourly average active power absorbed by all installations connected to the transmission or distribution grid, excluding the pumps of the pumped-storage stations.

Net Generating Capacity (NGC)

NGC of a power station is the maximum electrical net active power it can produce continuously throughout a long period of operation in normal conditions.

NGC of a country is the sum of the individual NGC of all power stations connected to either the transmission grid or to the distribution grid.

Unavailable Capacity

It is the part of NGC that is not reliably available to power plant operators due to limitations of the output power of power plants. It consists of the Non-Usable Capacity, Maintenance and Overhauls, Outages and System Services Reserve.

Reliably Available Capacity (RAC)

RAC on a power system is the difference between NGC and Unavailable Capacity. RAC is the part of NGC actually available to cover the load at a reference point.

Remaining Capacity (RC)

RC on a power system is the difference between RAC and Load. RC is the part of NGC left on the system to cover any unexpected load variation and unplanned outages at a reference point.

Reference Points

Reference points are the specific dates and times for which power data are collected. These points are characteristic enough of the whole studied period to limit the data to be collected to the ones at the reference points.

Spare Capacity

Spare Capacity is the part of NGC which should be kept available at reference points to ensure the security of supply in most of the situations. Spare Capacity is supposed to cover a 1% risk of shortfall on a power system i.e. to guarantee the operation on 99% of the situations.

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

Spare Capacity is estimated by the TSOs in each country, depending on its system's features; and for a set of countries (regions or whole ENTSO-E) as 5% of NGC.

Load Management (LM)

LM is the potential deliberate load reduction available at peak load to balance the system and ensure reliability. Only one long-term forecast scenario for load is referred to.

Margin Against Peak Load (MaPL)

MaPL is the difference between load at the reference point and the peak load over the period the reference point is representative of.

In SAF it is actually **Margin Against Seasonal Peak Load** for each reference point. That means 1 summer value (defined as the difference between the Load at the summer reference point and the forecasted summer peak load (peak load of quarter 2 and 3 of the reported year) and 2 winter values (defined as the difference between Load at each winter reference point and the forecasted winter peak load (peak load of quarter 1 and 4 of the reported year).

Adequacy Reference Margin (ARM)

ARM is the part of NGC that should be kept available at all time to ensure the security of supply on the whole period each reference point is representative of. ARM is calculated in order to cover the increase of load from the reference time point to the peak load and demand variations or longer term generation outages not covered by operational reserves. ARM is accounting for unexpected events affecting load and generation.

ARM in an individual country is equal to Spare Capacity plus the related MaPL.

ARM in a set of countries (regional blocks or whole ENTSO-E) is estimated as Sum of all individual MaPL values + Spare Capacity for a set of countries (as defined before).

Generation adequacy

Generation adequacy of a power system is an assessment of the ability of the generation on the power system to match the consumption on the same power system.

System adequacy

System Adequacy of a power system is a measure of the ability of a power system to supply the load in all the steady states in which the power system may exist considering standards conditions.

2.3 Methodology & Assessment

The adequacy analysis is based on the comparison between the available generation capacity and the load.

Generation Adequacy Forecast at reference point under Normal Conditions on power system is assessed at the reference points with the RC value.

- **When Remaining Capacity is positive, it means that some spare generating capacity is likely to be available on the power system under normal conditions.**
- **When Remaining Capacity is negative, it means that the power system is likely to be short of generating capacity under normal conditions.**

Seasonal Generation Adequacy Forecast in most of the situations is assessed through the seasonal extension of the Generation Adequacy Forecast on a power system, by the comparison of the related Remaining Capacity and Adequacy Reference Margin.

- **When Remaining Capacity is over or equal to Adequacy Reference Margin, it means that some generating capacity is likely to be available for export on the power system.**
- **When Remaining Capacity is lower than Adequacy Reference Margin, it means that the power system is likely to have to rely on import flows when facing severe conditions.**

Simultaneous Interconnection Transmission Capacity (SITC) of a power system is the overall transmission capacity through its peripheral interconnection lines. SITCs are calculated according to the former UCTE Transmission Development Plans. The SITC export value is called Export Capacity and may differ from the SITC import value, called Import Capacity. SITC values are potentially different at every reference points on every time horizons.

Transmission adequacy forecast aim at identifying potential congestions and potential need for developments of interconnection lines. In the present study it is limited to the assessment of needs resulting from security issues.

- **When Remaining Capacity is positive and lower than Export Capacity, it means that the spare generating capacity likely to be available on the power system can be exported under normal conditions at reference point.**
- **When Remaining Capacity is negative and its absolute value is lower than Import Capacity, it means that all the necessary import flows to meet load can be imported under normal conditions at reference point.**

Transmission adequacy forecast is assessed at the reference points with the comparison of RC, calculated under normal conditions, and SITC. It assesses the ability of a power system to transmit its own positive RC to its neighbouring power systems.

Seasonal Transmission Adequacy Forecast in most of the situations is assessed through the seasonal extension of Transmission Adequacy Forecast. It assess the ability of power system to meet its ARM with the necessary support of import flows from its neighbouring power systems or the ability of a power system to export its positive RM to its neighbouring power systems, if necessary.

- **When Remaining Capacity minus Adequacy Reference Margin is positive and lower than Export Capacity, it means that all the spare generating capacity likely to be available on the power system can be exported in most of the situations.**
- **When Remaining Capacity minus Adequacy Reference Margin is negative and its absolute value is lower than Import Capacity, it means that all the necessary import flows to meet load can be imported in most of the situations.**

Remaining Capacity concept is illustrated below in Figure 2.3.1.

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

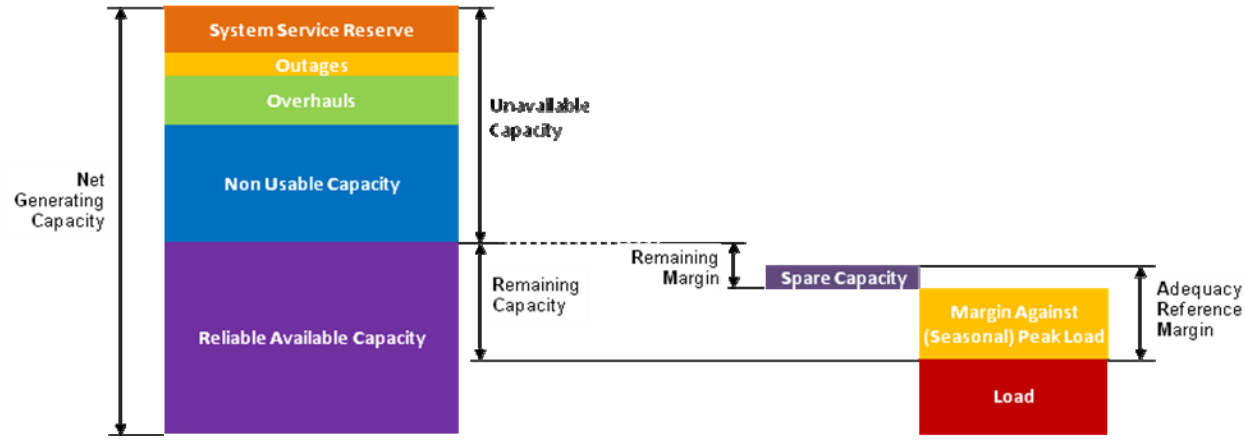


Figure 2.3.1: Generation Adequacy Analysis

2.4 Practical implementation

All input data for this report have been provided by the end of September 2009 by the TSOs, on a national basis, for the year 2010, 2015, 2016, 2020 and 2025. Any other years depicted in graphs or showed in figures are calculated as linear extrapolation and are only estimations. Furthermore, data provided for time period after the year 2020 should be considered as having quite a high level of uncertainty. It is caused by data availability/unavailability of the respective TSO along with the fact that lot of different national policies and important documents do not cover such long-term period, etc. Therefore the data used and shown after 2020 should be considered as a best estimation. When available, the data was supplemented by national comments.

Data has been provided for three reference points: 3rd Wednesday of January 11 a.m., January 7 p.m. (for Winter) and July 11 a.m. (for Summer).

Data has been provided for the two scenarios of generating capacity evolution (Conservative Scenario or Scenario A and Best Estimate Scenario or Scenario B).

Calculations and comparisons used in the report to characterise the reliability of a power system are calculated mainly for third Wednesday in January at 7 p.m. for Scenario B (unless otherwise indicated).

Generation adequacy is primarily analysed at whole ENTSO-E level (chapter 3) and national level (chapter 4). Some regional and transmission constraints analyses are reported in chapter 5 and 6. Input data and dedicated parts of this report will serve as an input for the upcoming Ten Year Network Development Plan due in 2010.

Note that for the future issues of SAF reports the methodology may be changed as a result of the ongoing methodology improvement developments by ENTSO-E.

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

3. ENTSO-E Adequacy Forecast

3.1 Demand and Load Forecast

Most of TSOs consider the influence of the economic crisis in their load and consumption forecasts saying that all provided forecasted load values are linked to the evolution of the GNP and could change according to future economic recovery/development.

Many countries reported quite strong load growth after the year 2015. In fact different factors can lead to apparently contradictory forecasts as far as the load growth rate is concerned. On the one hand some countries, for example Germany, France, Croatia, Poland and Portugal reported on the influence of energy savings programs and higher technological efficiency on the energy consumption growth. On the other hand the evolution towards low carbon energy consumption can be an incentive to move towards increased electricity uses especially in the transportation area.

Ultimately the evolution of load and energy is mainly influenced in each country by individual governmental policy and in the short term by stimulating programs to restart national economy after financial crisis. Some countries (e.g. France) report an influence of demography changes as well as influence of electricity prices regulation. Electricity price regulation can make electricity more attractive compared to other energy sources for different energy consumers.

Load growth is visible during the whole monitored time period in both reference points. Average annual load growth corresponds with following table (Table 3.1.1):

ENTSO-E annual average load growth	2010 to 2015	2015 to 2020	2020 to 2025
January 7 p.m.	1.32%	1.45%	1.21%
July 11 a.m.	1.49%	1.66%	1.32%

Table 3.1.1: ENTSO-E Annual Average Load growth

The load growth up to 2015 and after 2020 is in both reference points not as rapid as in the period between 2015 and 2020. This trend is slightly visible on the next figure as well (Figure 3.1.1.).

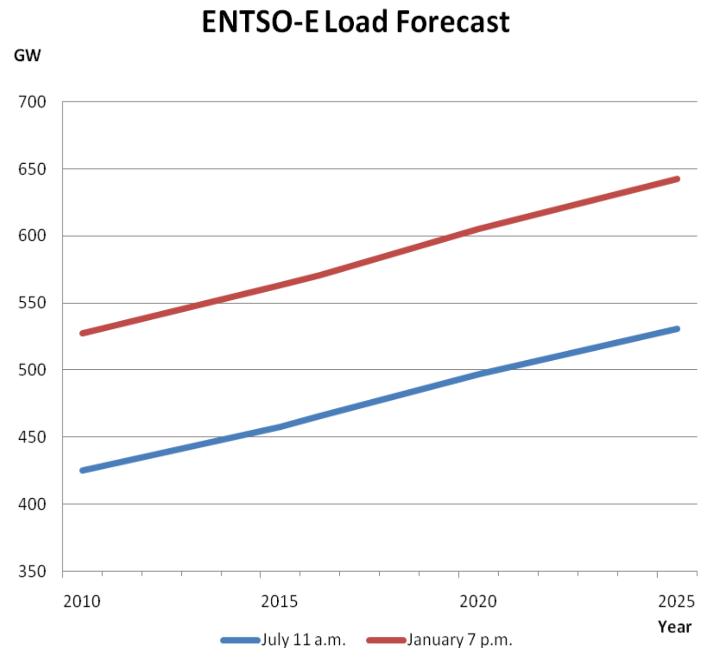


Figure 3.1.1: ENTSO-E Load Forecast comparison between January 7 p.m. and July 11 a.m.

ENTSO-E annual average load growth in period between 2010 and 2020 is shown in the Figure 3.1.2 below. The biggest increase show Cyprus (4.68%), Montenegro (4.29%), Iceland (3.4%) and Bosnia-Herzegovina (about 3.2%).

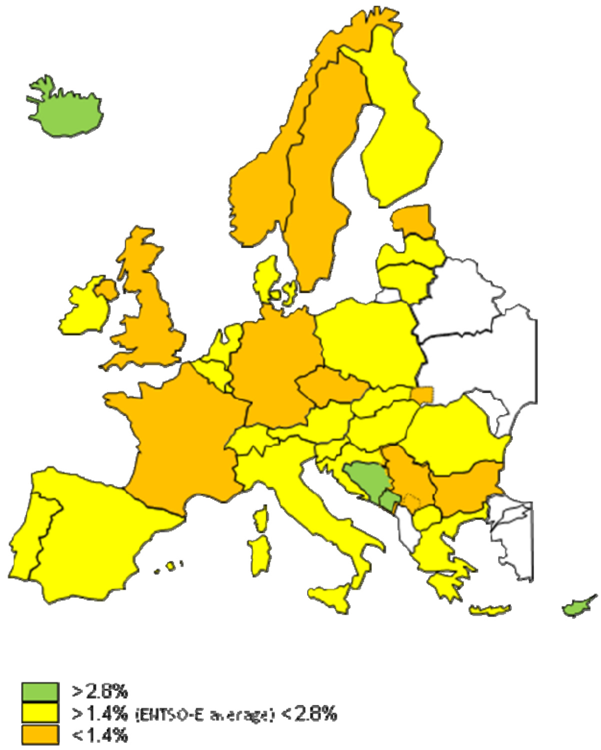


Figure 3.1.2: ENTSO-E Annual average load growth; from 2010 till 2020; January, 7 p.m.

Electricity consumption forecast is based on:

- The national growth rates of consumption delivered for the period 2010-2025 (no specific growth rate for 2009 was asked, the same growth rate between 2010-2015 was applied for 2009) by each TSO/national data correspondent within the SAF data collection process and SAF Report preparation,

- The grounds of:
    - former UCTE System Adequacy Retrospect 2008[9] report,
    - former NORDEL[10] and BALTSO[11] annual reports and
    - on the information about historical consumption obtained directly from some TSOs (e.g. Cyprus, Ukraine-West, Montenegro or Great Britain).

The ENTSO-E energy consumption forecast is shown on Figure 3.1.3 and the annual average energy consumption growth for ENTSO-E is shown in next table (Table 3.1.2).

Although the impact of the economic and financial crisis on load and energy consumption between 2008-2009 is expected to be more significant than in the period 2010-2015, the SAF energy forecast does not reflect this expectation since no specific values were collected for 2009 therefore no analyses have been performed for this year. The starting year for evaluations is 2008[12] (based also on former reports; see footnotes 9 to 11).

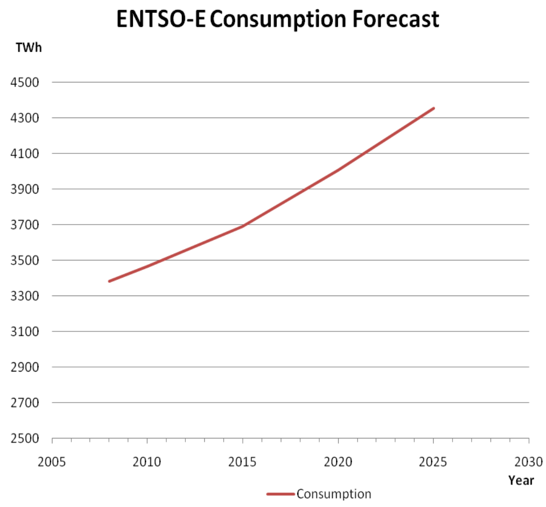


Figure 3.1.3: ENTSO-E Energy Consumption Forecast

	2010-2015	2015-2016	2016-2020	2020-2025
Annual Average Consumption Growth	1.26%	1.44%	1.70%	1.68%

Table 3.1.2: ENTSO-E Annual average consumption growth

The biggest annual average energy consumption growth is expected in Cyprus, Slovenia, Bosnia-Herzegovina and Bulgaria in all monitored time periods. This growth for each individual country for the period between 2010 and 2015 is depicted on following figure (Figure 3.1.4). As noted before, the energy consumption growth for the period between 2010 and 2015 may be assessed as "too optimistic" in relation to real impacts of the financial and economic crisis although all TSOs/national data correspondents tried to reflect it.

[9] http://www.entsoe.eu/index.php?id=58
[10] http://www.entsoe.eu/index.php?id=66
[11] http://www.entsoe.eu/index.php?id=88
[12] *Impact of economic and financial crisis between 2008-2009 is expected to be visible in the next ENTSO-E System Adequacy Retrospect Report 2009 (to be prepared in the year 2010).*

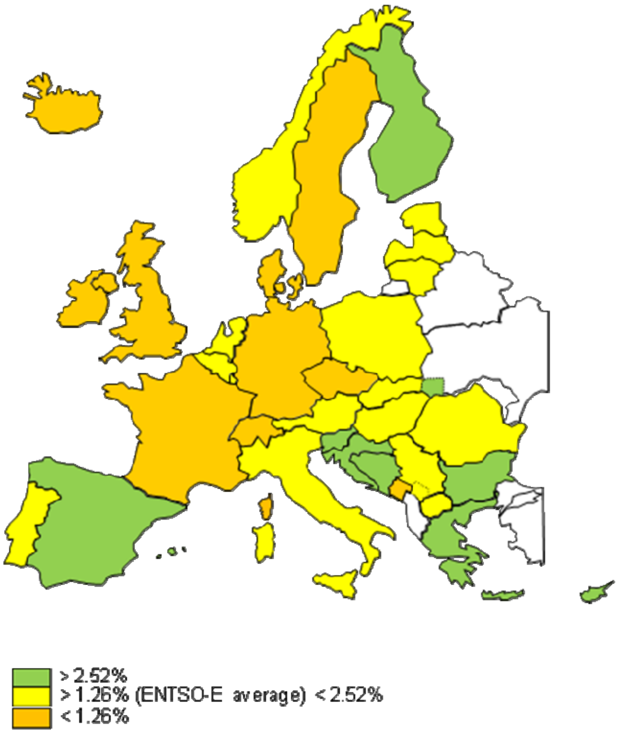


Figure 3.1.4: ENTSO-E energy consumption growth between 2010 and 2015

Concerning Load Management, only a few countries reported that they use this measure during power system operation. This factor is subject to legislation or market prices (e.g. the Netherlands). Another example is Croatia, where the legislation about Load Management Measures is now undergoing a preparatory process. For more details about this topic see the national comments section.

3.2 Generating Capacity Forecast

In terms of forecasting, it is thought that the full impact of the economic and financial crisis on generating capacity development may not be yet fully known. It may lead to additional delayed and frozen generation projects not yet taken into account by TSOs in their forecasts.

Until 2015, the Net Generating Capacity is increasing in both of scenarios (see Figure 3.2.1). After this term in conservative Scenario A there is a small decrease of NGC about 3 GW (from 984 GW in 2015 to 981 GW in 2016). Then the NGC starts to increase very slowly again (1007 GW in 2020 and 1010 GW in 2025). It can be linked to the fact that classical thermal units typically have a lead time of around 5 years (the lead time for nuclear unit is around 10 years). Therefore, TSOs are probably not able to take into account ”certain” projects for classical thermal units after 2015 when preparing scenario A. Meanwhile TSOs will try to forecast the decommissioning dates of some older units using reference technical lifetimes. Hence, in Scenario A, the NGC development after 2015 is influenced by the decommissioning of older units with commissioning of a small amount of new units (just a few nuclear ones up to 2020).

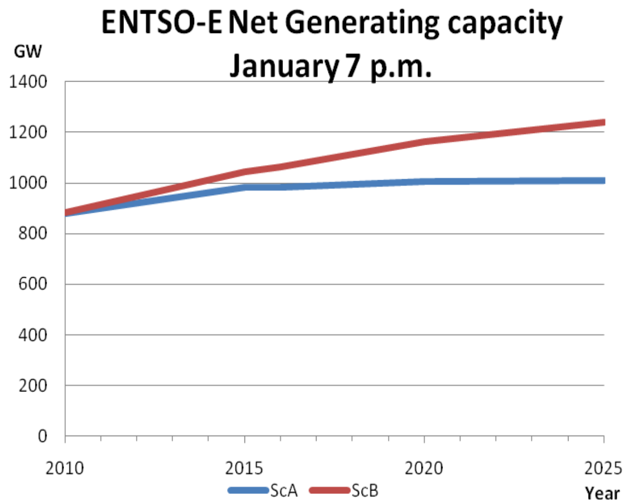


Figure 3.2.1: ENTSO-E Net Generating Capacity

Scenario B, on the contrary, shows continuous increase of NGC. The highest increase is reported for the period from 2010 to 2015. After 2020, the lowest growth rate is identified. Further to the adding of existing projects up to 2015 or 2020 for nuclear units, TSOs tend to take into account longer-term forecasts based on existing and likely future policies (e.g. climate change) and investment signals (e.g. related to the forecasted load increase). Therefore national forecasts for scenario B do not necessarily reflect a business as usual scenario prolonging the existing trends but can also be a best estimate of the likely investments (see Methodology in chapter 2). More details can be found in the National comments section.

It is also important to bear in mind that the time period after 2020 is based on data with a higher level of uncertainty than the data given for the near future. It is caused by data availability/unavailability to the respective TSO along with the fact that a lot of the different national policies, which are used by the TSOs´ for their long term forecast, do not cover such a long-term period, etc.

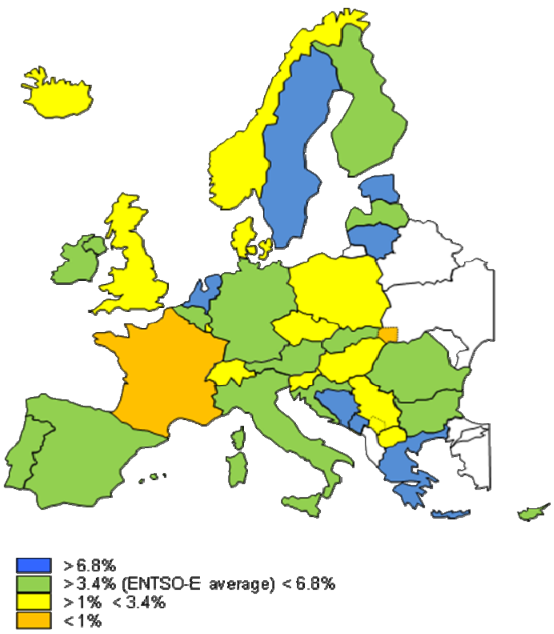


Figure 3.2.2: Net Generating Capacity annual average growth per country in January 7 p.m. from 2010 to 2015; Scenario B

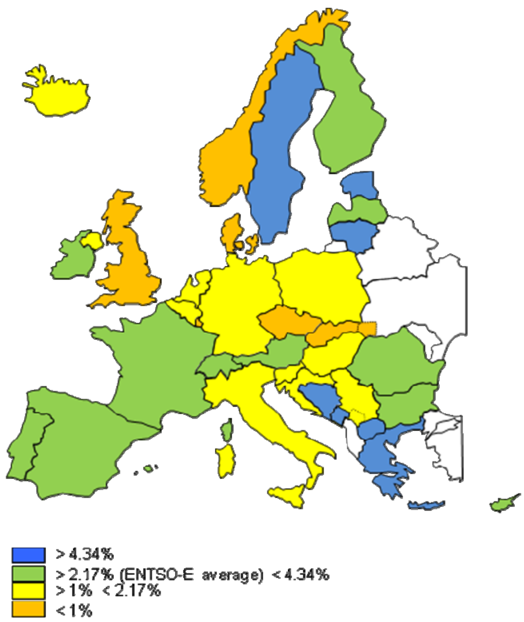


Figure 3.2.3: Net Generating Capacity annual average growth per country in January 7 p.m. from 2015 to 2020; Scenario B

The maps above (Figure 3.2.2 and 3.2.3) show NGC increase per country from 2010 to 2015 and from 2015 to 2020 for Scenario B. The biggest annual average increase of NGC is visible in Bosnia – Herzegovina, Estonia, Greece, Lithuania, Montenegro, and Sweden. For the first 5 years, the Netherlands belongs to this list, however, for the subsequent 5-years period, its growth rate will decrease. NGC growth rate in the Former Yugoslavian Republic of Macedonia will increase significantly for the time period 2015-2020. All mentioned countries show a two times higher increase of NGC than the ENTSO-E average (for the period 2010-2015 the ENTSO-E average value is 3.4% and for the period 2015-2020 it is 2.17%). These national increases in NGC cannot solely be explained by an increase of national load (see paragraph 3.1.). National policies for security of supply and international trade may also be strong incentives. Furthermore these increases in installed capacity are somewhat tempered when considering the available capacity (e.g. wind power, see also Chapter 3).

Although the financial and economic crisis will influence investments in generating units in the short run, the impact on the long-term forecast of investments in generation will be less sensitive to a temporary economic downturn. Yet, some might be questioned by an enduring credit crunch and permanent load reduction due to the closure of electro intensive industrial sites. Both could lead to some projects being postponed or even cancelled. Therefore, TSOs will have to closely monitor the development of the economic situation.

3.2.1 Generation mix

The most developing energy source is forecasted to be the Renewable Energy Sources (other than hydro; further only “RES”) followed by some types of fossil fuels, mainly gas (Figure 3.2.4 below).

RES capacity (excluding hydro) shows the biggest increase among all primary energy sources with an increase of about 219 GW. After 2017 RES installed capacity (excluding hydro) is the second energy source after fossil fuels in the ENTSO-E area. It will surpass not only the installed capacity of nuclear in 2012 (see paragraph 3.2.5) but also the installed capacity in hydro power plants in 2017. It is depicted on the Figure 3.2.5 below. However, it is important to note that an increase in installed capacity of wind or solar generation has not the same availability factor as the conventional fuels or biomass. Related remarks are stated in following sub-paragraphs.

The second most developing energy sources are fossil fuels (almost 100 GW increase from 2010 to 2025). It is also remarkable to note that the installed generation capacity of nuclear is remaining quite stable until 2015. Between 2015 and 2020 there is a minor decrease of the nuclear installed capacity. However between 2020 and 2025 there is an increase of nuclear capacity, resulting in installed capacity that is 5 GW higher than the installed capacity today.

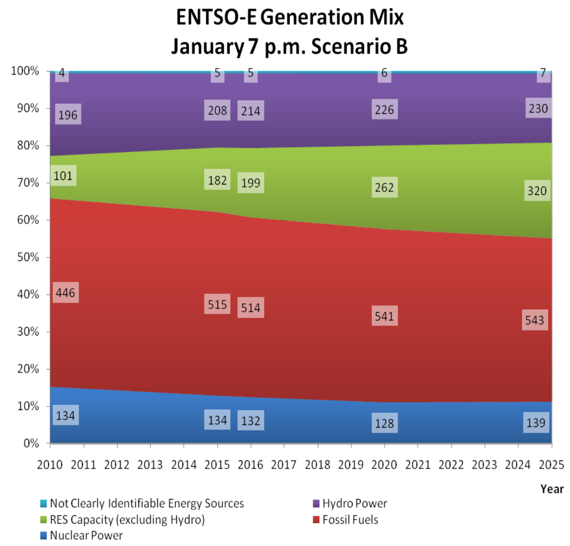


Figure 3.2.4: ENTSO-E Net Generating Capacity Mix

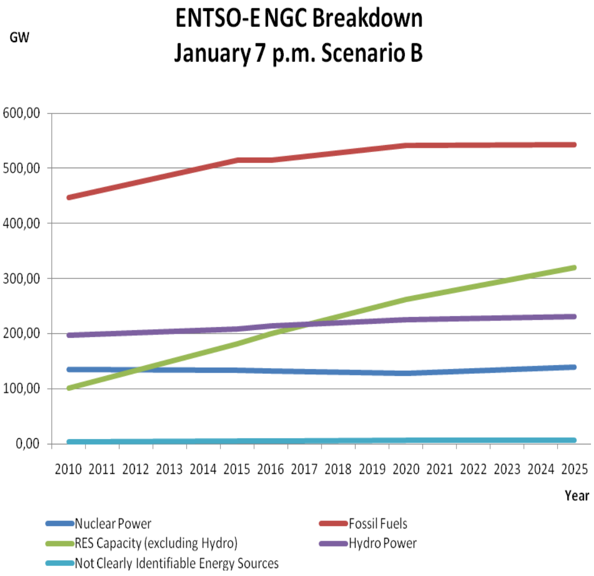


Figure 3.2.5: ENTSO-E Net Generating Capacity Breakdown

The biggest contributors to the total generation capacity within ENTSO-E are Germany and France followed by Italy, Spain and Great Britain (see Figure 3.2.6 below). The biggest share in generation mix based on installed capacity of most of these countries is filled in by fossil fuels (in Germany, Italy, Great Britain and Spain) and in France it is nuclear energy (Figure 3.2.7).

From the whole ENTSO-E point of view almost 50% of generation capacity is covered by fossil fuels in both scenarios (from 51% in 2010 to 44% in 2025). Their share decreases significantly only in time horizon of 2025. Only the share of RES (excluding hydro) on the contrary increases all the time (from 11% in 2010 to 26% in 2025). Their percentage is more than doubled from 2010 to 2025. The mentioned percentages however do not reflect the actual use of installed generation capacity for the production of electricity.

Share of other types of primary energy sources is decreasing continuously and do not show such significant changes. Some additional remarks regarding above mentioned developments are reported in following paragraphs.

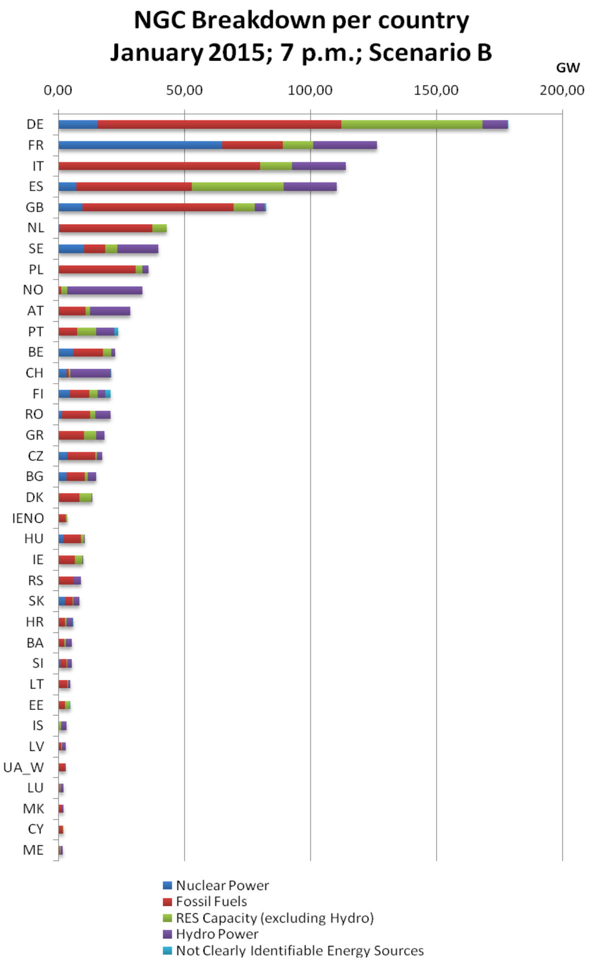


Figure 3.2.6: Net Generating Capacity Breakdown

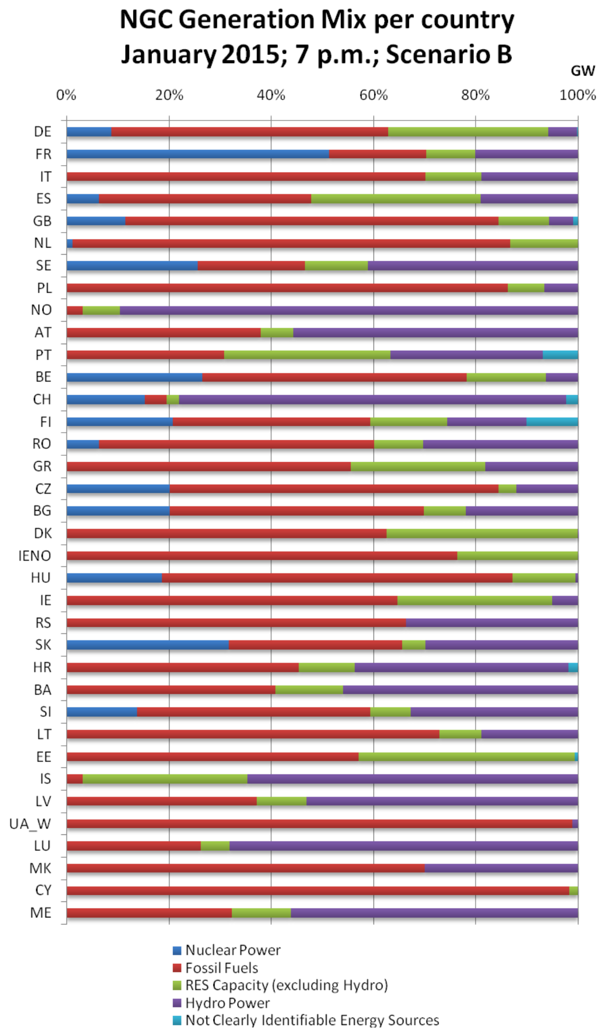


Figure 3.2.7: Net Generating Capacity Generation Mix

3.2.2 Large Combustion Plant Directive and decommissioning

Large Combustion Plant Directive[13,14] (hereinafter LCP Directive) applies to combustion plants with a rated thermal output equal to or greater than 50 MW, irrespective of the type of fuel used. The Directive sets pollutions thresholds for NO_X, SO_X, dusts etc. Existing units in question must abide by these standards by the December 31st, 2015, at the latest or must be shutdown. Defined limits will be revised down again in 2016.

If an operator of an existing plant seeks exemption from compliance with the requirements set in the Directive, their output is also limited to a 20,000 operational hours starting from January 1st, 2008, and ending no later than December 31st, 2015.

The LCP Directive commits only European Union (EU) member states. Therefore ENTSO-E member countries outside of EU perimeter do not have to follow its goals.

Only very general information on the amount of decommissioning that will take place is available with exception of units mentioned in directives IPPC[15] (Directive 2008/1/EC, Integrated Pollution Prevention and Control) or LCP Directive or in national laws. Some units under IPPC and LCP Directive have operational limits, yet these are not always clear to the TSO. More generally, the operational availability of older units is not always clear.

Foreseen decommissioning is mainly coal and oil units and secondarily nuclear (extended operation or replacement). The foreseen substitution capacities are mainly gas fired.

From SAF point of view it is interesting to focus on 2015 and 2016, when a decrease of fossil fuels installed capacity is expected for all EU countries (Figure 3.2.8, grey frame).

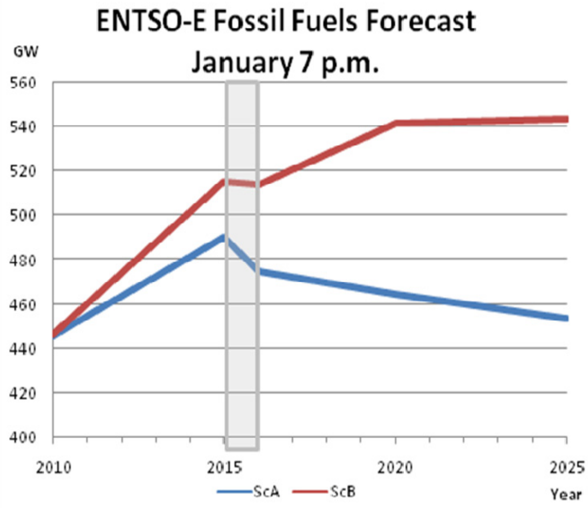


Figure 3.2.8: ENTSO-E Fossil Fuels forecast

As the figure above shows, the decrease of installed capacity in fossil fuels after 2015 is visible in both scenarios. However it is not as significant as might have been expected. In Scenario A the decrease from 2015 to 2016 is only about 3% and in Scenario B it is only 0.19%. In Scenario A the decrease continues (about 2.5% decrease from 2016 to 2020 and from 2020 to 2025 as well). In Scenario B the decrease stops in 2016 and in following years

[13] *Directive 2001/80/EC of the European parliament and of the Council of 23 October 2001 on the limitation of emissions of certain pollutants into the air from large combustion plants*

[14] *The Commission adopted on 21 December 2007 a Proposal for a Directive on industrial emissions. The Proposal recasts seven existing Directives (including the IPPC Directive, the Large Combustion Plants Directive, the Waste Incineration Directive, the Solvents Emissions Directive and 3 Directives on Titanium Dioxide the IPPC) into a single clear and coherent legislative instrument.*

[15] *http://europa.eu/legislation_summaries/environment/air_pollution/l28028_en.htm*

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

there is increase of about 5% from 2016 to 2020. From 2020 to 2025 the increase is only 0.35%.

The main contributors to the fossil fuels installed capacity decrease between 2015 and 2016 are Great Britain and Poland in both scenarios. In Scenario B it includes -2.74 GW for Great Britain and -1.5 GW for Poland. These countries are followed by Northern Ireland, France, Denmark, Romania and some other countries with quite small decreases of this capacity in their capacity mix. This is clear visible in the map below (Figure 3.2.9). There are also some countries which show an increase of fossil fuels capacity in this time period (e.g. Germany and the Netherlands; both countries +1.4 GW).

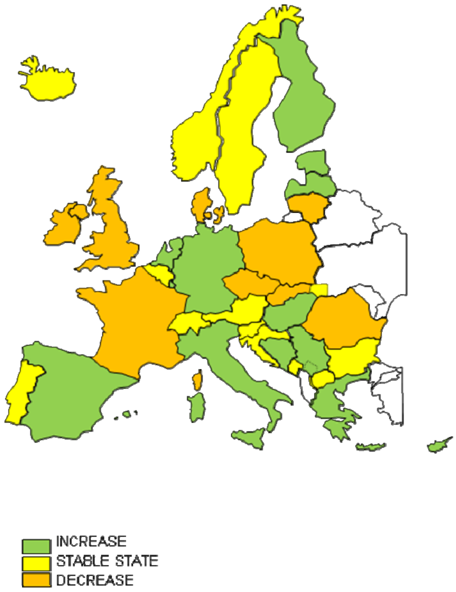


Figure 3.2.9: Fossil Fuels installed capacity increase/decrease between the years 2015 and 2016 per country; Scenario B

Focusing on EU member states one can see that the course of ENTSO-E fossil fuels installed capacity matches the course of fossil fuels installed capacity in EU member states. Also here the decrease between 2015 and 2016 is clearly visible. In Scenario A it is 3.2% and in Scenario B just 0.3%. By contrast, in non EU member countries a continual increase of fossil fuels installed capacity (in Scenario A it is 1.6% and in Scenario B 3.2%) can be observed. This trend for EU member and non-member states is preserved also in other time periods in both scenarios. With the exception of the period 2015-2020 in Scenario B when fossil fuels installed capacity in EU member states show also an increase.

In the figures below (Figures 3.2.10 and 3.2.11) ENTSO-E fossil fuels installed capacity breakdown 2015 and 2016 is depicted. The figures show that the most significant decrease is expected in hard coal and oil power plants (see also Figures 3.2.12 and 3.2.13). Other types of fossil fuels show only minor decrease in comparison to the first two ones. Only the installed capacity in gas power plants increases in both scenarios (more about this issue in the next paragraph).

Next figures show ENTSO-E hard coal and oil power plants installed capacity forecast.

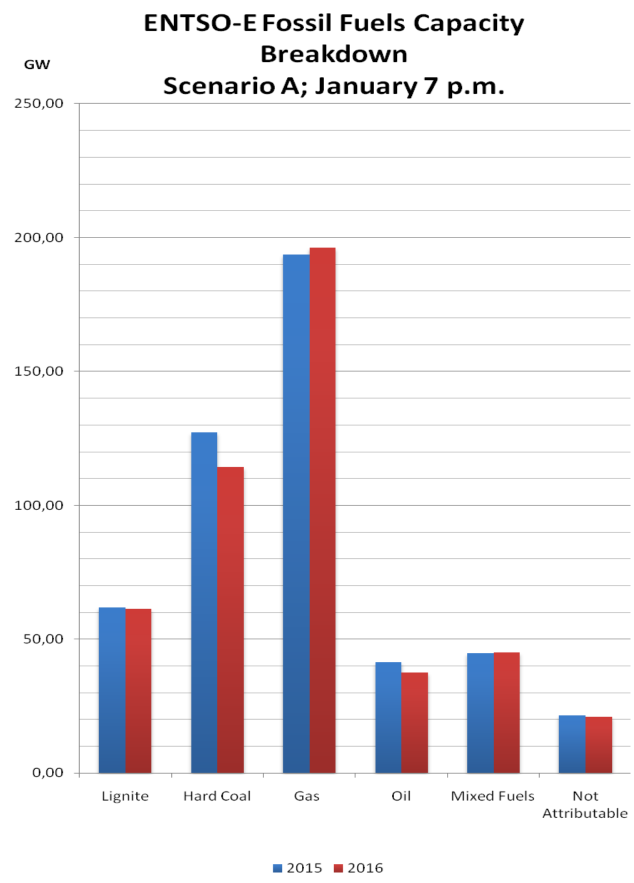


Figure 3.2.10: ENTSO-E Fossil Fuels Capacity Breakdown

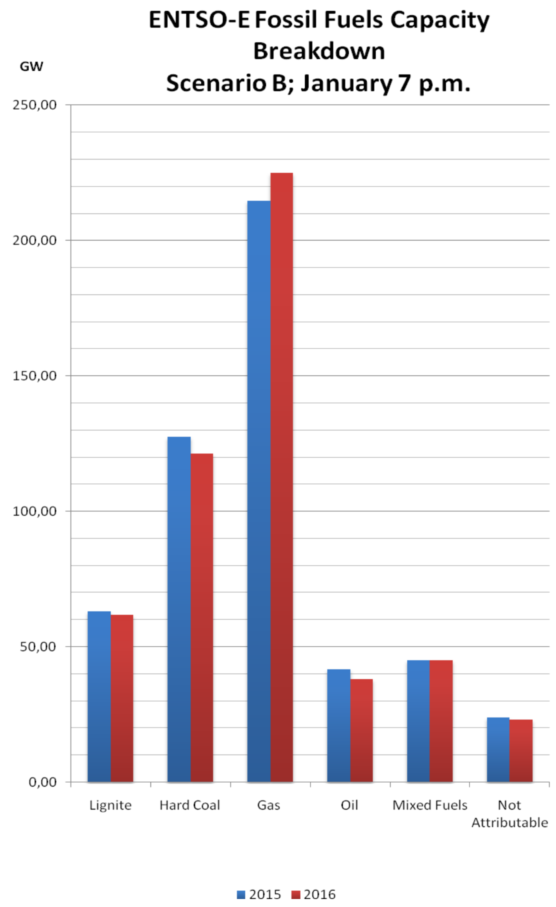


Figure 3.2.11: ENTSO-E Fossil Fuels Capacity Breakdown

For the hard coal category there is a visible decrease of installed capacity in both scenarios. In Scenario A the total decrease is 11% between 2015 and 2016. Considering the period between 2015 and 2025 the decrease is 24%. Main contributors are Poland (decrease almost 4 GW from 2015 to 2016 and 5 GW in 2018; total decrease up to 2025 is about 9 GW) and Great Britain (total decrease is 8 GW from 2015 to 2025) followed by Denmark, France and Spain. In 2025 also other countries show certain decrease of that installed capacity (e.g. Portugal and Finland).

In Scenario B after the total 5% decrease from 2015 up to 2016 (mainly in Poland (3 GW) and Great Britain (1.5 GW), but also to a smaller extent Spain, Denmark, France and Romania) the installed capacity of hard coal power plants increases slightly. However in the period between 2020 and 2025 there is a visible hard coal decrease again (Great Britain, Denmark, Finland, Portugal, Germany and other smaller contributors).

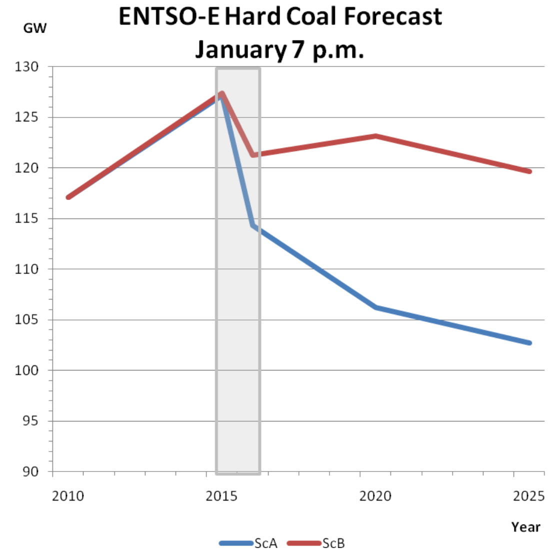


Figure 3.2.12: ENTSO-E Hard Coal Power Plants Forecast

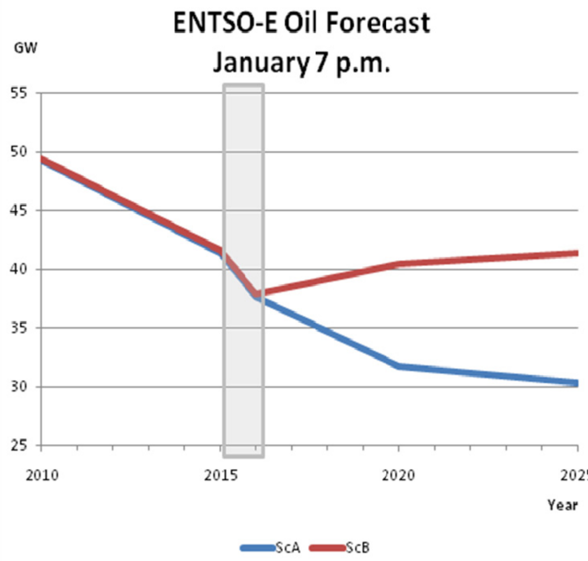


Figure 3.2.13: ENTSO-E Oil Power Plants Forecast

For oil power plants there is a visible continuous decrease of installed capacity in Scenario A (from 2010 to 2025 there is a total decrease of about 63%). But in Italy[16] there is at the same time period an increase of 1.6 GW. In Scenario B there is a visible decrease of oil power plants installed capacity from 2010 to 2016 about 30% (mainly Germany, Portugal, Spain, Great Britain and Sweden) and from 2016 on the installed capacity in oil power plants is increasing again (8% from 2016 to 2025) in Italy again (0.5 GW) but also in France quite a big increase of this kind of capacity is foreseen in time period 2016-2025 (about 5.7 GW).

3.2.3 Gas

Installed capacity in gas power plants is only one of the increasing energy sources within fossil fuels category. The increase is continual from 2010 to 2025 (Figure 3.2.14) and makes 23% in Scenario A (1.76% average growth rate per year) and 39% in Scenario B (3.33% average growth rate per year). The given figures do not necessarily reflect the actual usage of gas power units.

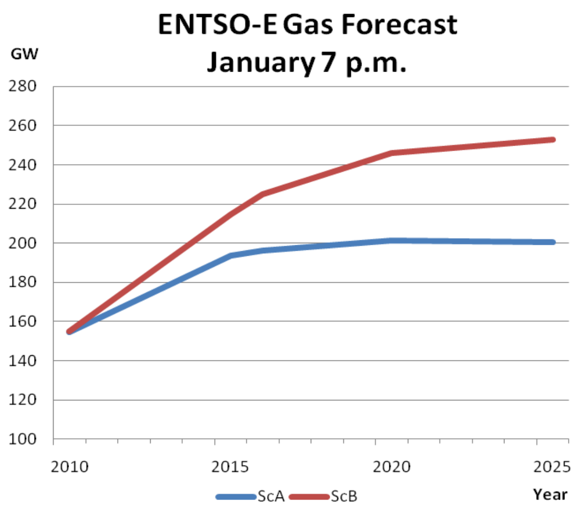


Figure 3.2.14: ENTSO-E -E Gas Power Plants Installed Capacity Forecast

16 *In Italy oil category includes fuel oil, diesel oil, petroleum coke, LPG, refinery gas, naphtha, kerosene*

The share of gas power plants in total fossil fuels installed capacity is significant and it reflects the favouring of gas power units among potential investors (Figure 3.2.15) due to their lower investment costs and higher flexibility compared to other thermal units. More, existing climate change policies tend to favour gas power units as less CO_2 emitter than coal power units.

Some of these investments are directly driven by the present incentives for the development of RES capacities (excluding hydro) resulting in the forecast of an high increase in RES capacity (excluding hydro; see paragraph 3.2.4) and the high volatility of this type of generation, more specific wind farms and solar panels, which requires flexible and reliable backup capacities.

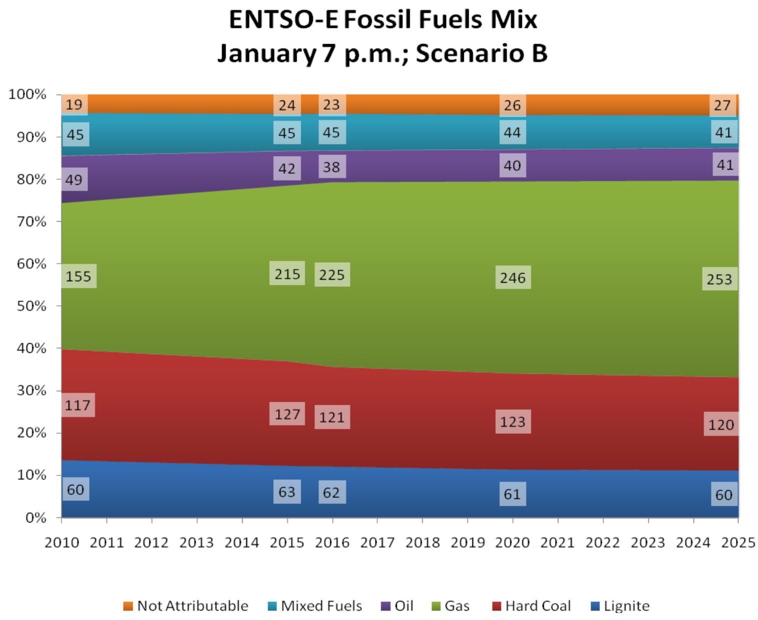


Figure 3.2.15: ENTSO Fossil Fuels Mix

This is a trend which potentially increases Europe's dependency on gas supply. Gas is one of primary energy sources which have to be imported (more or less) into all of the ENTSO-E countries. Thus, security of supply from electrical point of view is getting more and more dependent on the supply, transport and storage capacities for gas. This remark was also pointed out for example in the latest Winter Outlook Report[17] (in consequence of last year's gas crisis).

[17] http://www.entsoe.eu/index.php?id=50

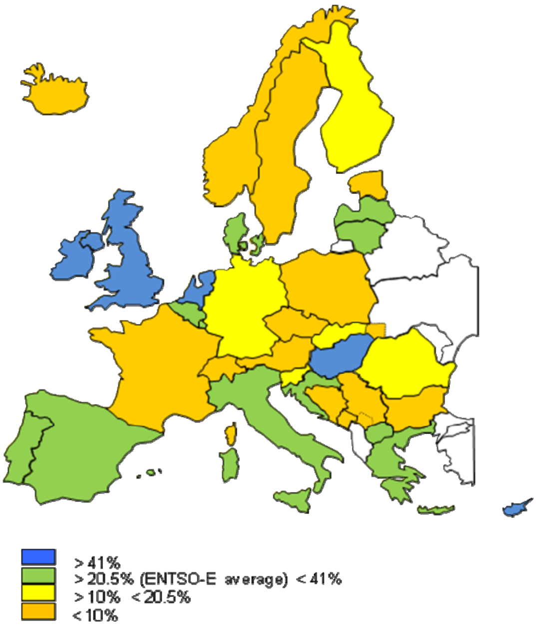


Figure 3.2.16: Share of Gas power units in NGC per country in January 2015, 7 p.m., Scenario B

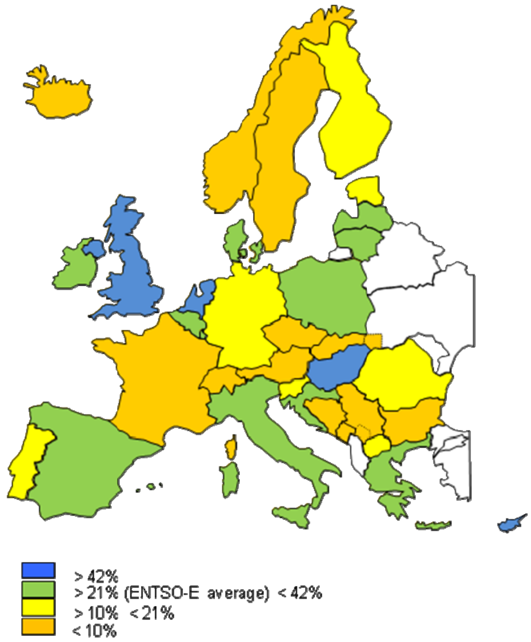


Figure 3.2.17: Share of gas power units in NGC per country in January 2020, 7 p.m., Scenario B

Figures 3.2.16 and 3.2.17 show the share of gas power units in the NGC per individual ENTSO-E member country. For example the Netherlands and Cyprus have more than 50% share of gas power units; Hungary, Northern Ireland and Republic of Ireland have a 50% share of gas power units (or almost 50%); Great Britain, Belgium and Lithuania have a share of gas power units in the NGC of about 40%. But there are also countries with no gas power units (Austria, Iceland). The given figures do not necessarily reflect the actual usage of gas power units.

3.2.4 RES prognosis

3.2.4.1 Hydro generation

Although hydro generation is a major part of the foreseen RES production, it poses a special challenge since the pure pump storage part is not recognized as RES. However there are hydro power units that combine the possibility of pump storage with natural inflow. Hence TSOs are not always able to identify if the hydro capacity can be classified as a RES capacity, although this is not true for actual generation. Therefore hydro capacities are analysed separately in this SAF Report and not added to the capacities that are clearly identified as RES. For instance countries like Norway and Sweden are in the Figures 3.2.20 and 3.2.21 shown with a quite low RES-share. In reality Sweden has a RES-share of about 50% and Norway a RES-share of about 97% when including RES-classified hydro.

Focusing only on hydro power plants in Scenario B it is visible that in the periods 2010-2015 and 2016-2020 the total hydro power plants installed capacity increases by about 11.9 GW whereas between 2015 and 2016 the increase is about 5.62 GW and after 2020 only 4.6 GW. The main contributors to this increase in capacity are Austria, Switzerland, Spain and Portugal. In Portugal, between 2010 and 2020, almost 4.5 GW of new hydro installed capacity is expected, which represents an increase of 97%. In Spain a repowering of about 500 MW in older units is expected by 2015 and construction of new pure pumping units is considerable (around 3 GW in operation before 2016).

Share of Hydro power plants installed capacity in Net Generating Capacity is depicted on next figures (3.2.18 and 3.2.19). Countries with the highest share of hydro power plants in their total capacity mix in both years are: Norway (90% in 2015 and 88% in 2020), Switzerland (76% and 78%), Luxemburg and Iceland (both countries about 65% in both years) and Austria, Latvia, Montenegro and Bosnia-Herzegovina (with the share between 45% and 65%).

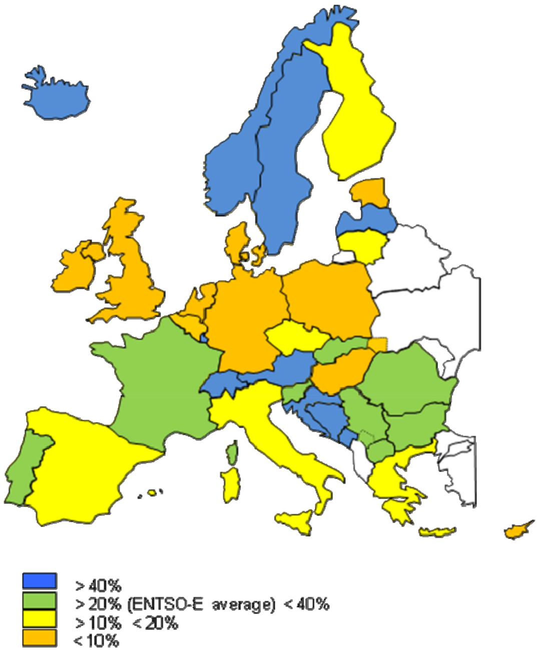


Figure 3.2.18: Share of Hydro power units in NGC per country in January 2015, 7 p.m., Scenario B

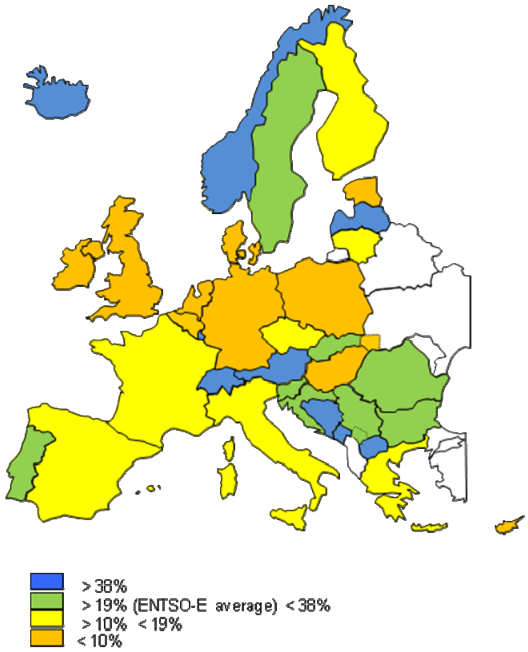


Figure 3.2.19: Share of Hydro power units in NGC per country in January 2020, 7 p.m., Scenario B

The biggest development in each time period is in pure pumped hydro power plants. It is mainly after 2015 that this increase occurs (till 2015 the increase is about 4.6 GW while it is 12.2 GW between 2015 and 2025) and is probably closely linked to the RES capacity development, especially with the growing development of off-shore wind farms (see next paragraphs). For more information see Chapter 5.

3.2.4.2 Other RES

This chapter refers to the RES capacity assessment (excluding hydro power installed capacity).

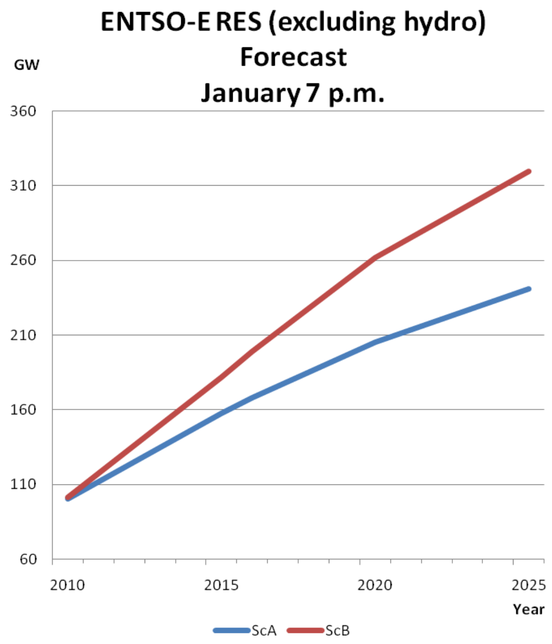


Figure 3.2.20: ENTSO-E Renewable Energy Sources Forecast

On the figure above (Figure 3.2.20) there is a visible continuous increase of Renewable Energy Sources (other than hydro) in both scenarios within the time period 2010-2025. In Scenario A the annual average growth is 6.02% per year and in Scenario B it is 7.95% per year (based on the evolution of the values for January 7 p.m.). However this growth of RES capacity (excluding hydro) is visible in each reference point. The main contributors in the period 2010-2025 are Germany (45.8 GW), Spain (39.9 GW), France (26.8 GW), Italy and Great Britain (both about 17.5 GW). The next figures reflect the share of RES (excluding hydro) in NGC in the different individual countries (Figure 3.2.21 and 3.2.22), making it clear that the share of RES (excluding hydro) increases in almost all countries over time.

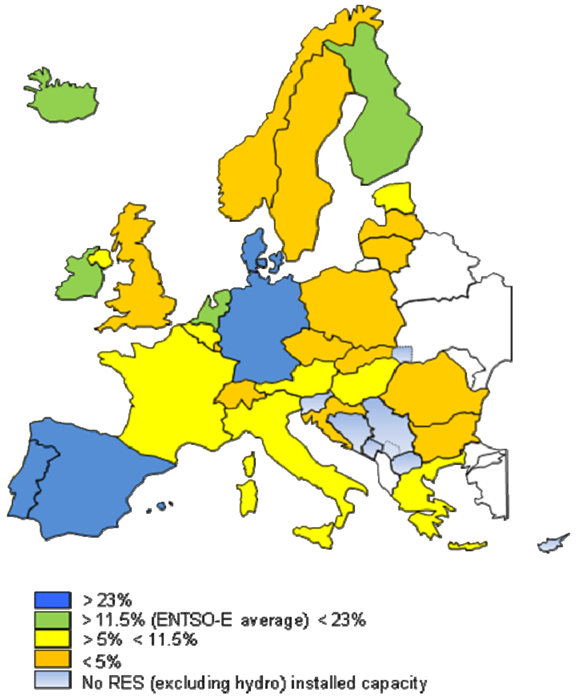


Figure 3.2.21: Renewable Energy Sources (excluding hydro) installed capacity as a part of NGC per country in January 2010, 7 p.m., Scenario B

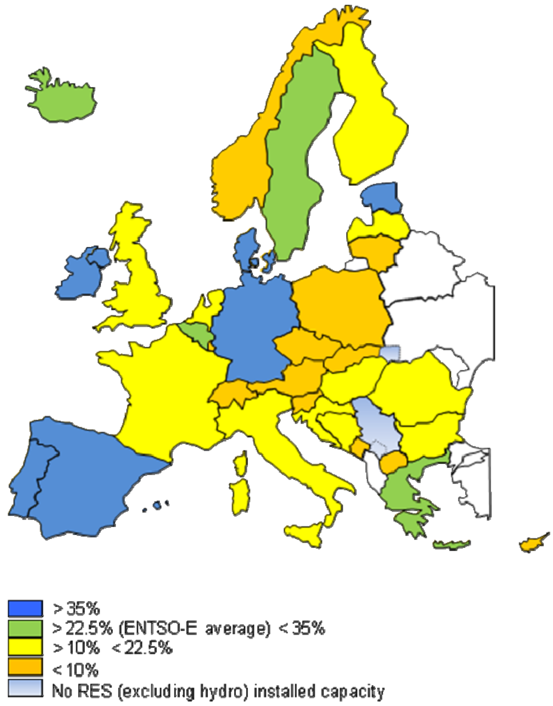


Figure 3.2.22: Renewable Energy Sources (excluding hydro) installed capacity as a part of NGC per country in January 2020, 7 p.m., Scenario B

The increasing RES capacity (excluding hydro) corresponds mainly with wind farms developments – in other words, wind farms are mainly responsible for the RES capacity development (excluding hydro) within ENTSO-E (Figure 3.2.23). Solar power plants show on the contrary the biggest annual average growth rate among all of the RES capacity (excluding hydro) in both Scenarios and in each reference point (in the figure below the average annual growth of solar panels is 10.15% per year; for wind farms it is “only” about 8%). This high growth rate for solar panels is mainly linked to the low penetration level of solar panels in 2010.

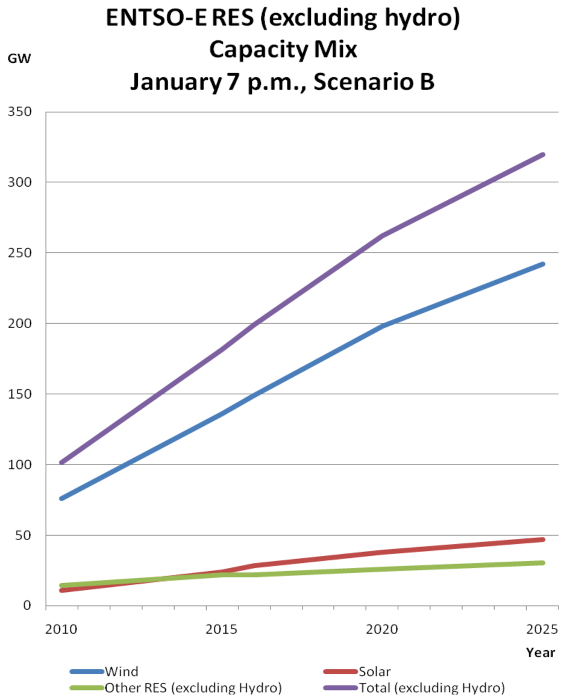


Figure 3.2.23: ENTSO-E Renewable Energy Sources installed capacity mix

This continuous increase in RES capacity (excluding hydro) is mainly influenced by the EU policy regarding renewable energy sources which is translated into individual state policy. EU and its member states, as well as lot of non-member states, adopt different legislative measures aiming to contribute to the living environment protection and sustainable living. The main EU documents in this field are related to the climate-energy legislative package adopted in April 2009. The package contains measures for the fight against climate change and promotes renewable energy utilisation. It is designed to achieve the EU's overall environmental target of a 20% reduction in greenhouse gases, a 20% decrease in energy consumption and a 20% share of renewable energy in the EU's total energy consumption by 2020. The translation of these European objectives towards national objectives does not result in the same measures being implemented in all countries. National governments usually implement measures tailored for their specific national features. National policies could favour for e.g. special advantageous feed-in tariffs for RES or special conditions for access and connection to the grid for RES or other additional subsidies for RES. All statements above concern mainly wind and solar power plants.

Such support is a major motivation for potential investments in RES (excluding hydro) but at the same time it results in different challenges for the TSOs (sufficient system service reserve, bottlenecks, operational and safety problems, etc.). The implementation of such legislation and development of any new rule in relation to RES generation (excluding hydro) as well as to the connection and access of this type of generation to the transport/distribution grid should therefore take into consideration the challenges it imposes on the TSOs. The increasing share of windmills and solar panels in NGC increases the need for more flexible back-up capacity that can cope with the high fluctuations of generation of this type of power plants. The most flexible fossil fuel power plants are gas power units, current generation forecasts foresee a high increase in this type of power plant (see paragraph 3.2.3). And as stated at the beginning of this chapter, the capacity of pure pumped hydro power plants is also increasing and probably this is also to cope with the high volatility of electricity produced by RES generation (excluding hydro).

In countries outside the EU, the increase of RES capacity (excluding hydro) is not so significant. In Bosnia-Herzegovina, Ukraine-West, Serbia and Montenegro there is no RES installed capacity (excluding hydro) reported in any Scenario and reference point. Former Yugoslavian Republic of Macedonia shows an increase only in Scenario B (0.1 GW in period 2016-2025). However Switzerland, Norway and Croatia show higher RES increases (excluding hydro) than the ENTSO-E average but only in Scenario B (except for Croatia, it shows also a higher increase in Scenario A).

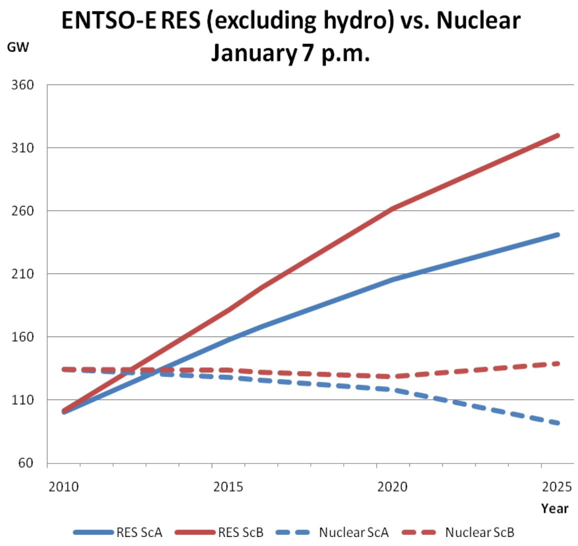


Figure 3.2.24: ENTSO-E Renewable Energy Sources vs. Nuclear power capacity

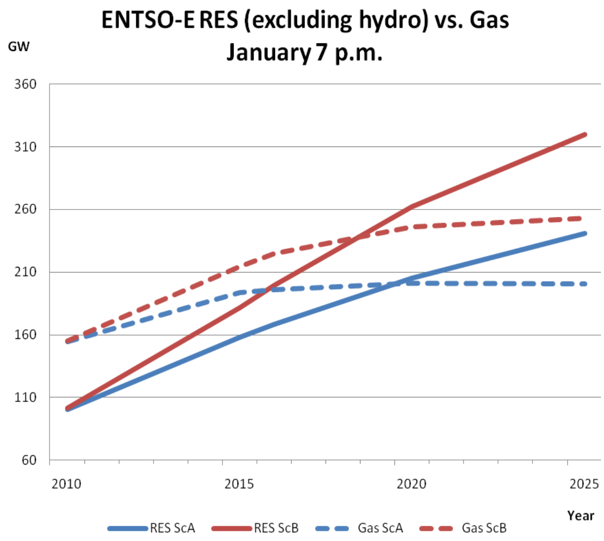


Figure 3.2.25: ENTSO-E Renewable Energy Sources vs. Gas power capacity

The capacity of RES (excluding hydro) and fossil fuels power plants are the two categories with the highest share in generation mix. The installed capacity of nuclear power plants does not change very rapidly until 2020 and after this year in Scenario A the capacity is decreasing at a higher pace while in Scenario B it starts increasing again. However, based on the figures above it seems that the growth in fossil fuel and nuclear power plants is in some extent stopped by an increasing growth in RES capacity (excluding hydro) although in Scenario B it is less obvious (Figures 3.2.24 and 3.2.25). However, RES (excluding hydro) and thermal units do not have the same availability of their installed capacity due to the different maintenance cycles as well as the availability of primary energy (see paragraph 3.2.6). The availability of flexible back-up units for RES capacity (excluding hydro) is vital for maintaining a high level of security of supply.

3.2.5 Nuclear power plants issues

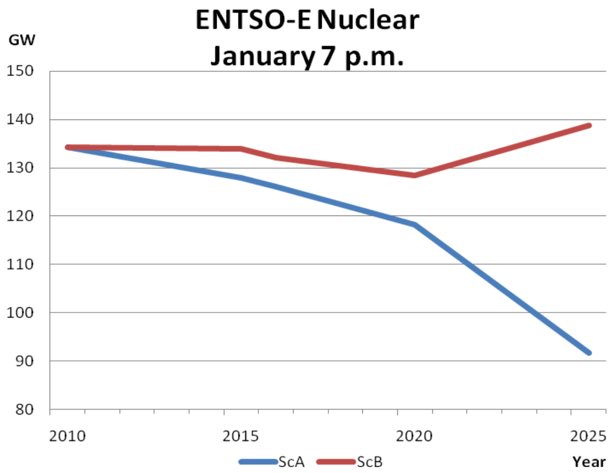


Figure 3.2.26: ENTSO-E Nuclear Installed Capacity Forecast

The installed capacity of nuclear power plants reduces in both scenarios until 2020. This year is a milestone in Scenario B in which nuclear installed capacity starts increasing again (Figure 3.2.26). The situation is identical in each reference point.

From 2010 up to 2025 in Scenario B the installed capacity of nuclear power plants increases in several countries (Czech Republic, Finland, Lithuania about 3 GW; Bulgaria, Switzerland, France about 2 GW, Great Britain, Slovakia, Hungary, Romania, Slovenia and some others about 1 GW). On the contrary in Germany, Belgium and Spain the installed capacity in nuclear power plants decreases in the same time period by 14.3 GW, 3.81 GW and 0.5 GW respectively. It is visible in each reference point in this Scenario B. However in Germany as well as in Belgium governments are reviewing the existing nuclear phase out law.

In October 2009 the Belgian government announced their intention to postpone the nuclear phase out by 10 years. This information is not in the current generation scenarios of Belgium because the data was collected in September 2009.

The phase-out of nuclear power stations in Germany which was decided by previous German government is again under discussion. The election in autumn 2010 will probably lead to different political constellations compared to previous forecasts. That could have also an effect on the future operational utilisation of the existing nuclear power stations.

In 2025 Italy is expected to become a “nuclear country” again because for this year the commissioning of the first nuclear power plant (1.4 GW) is foreseen, following a 35 years moratorium period, during which nuclear power plants, according to law, were not allowed. After the decommissioning of Ignalina power plant, Lithuania will re-obtain nuclear capacity with the commissioning of new nuclear unit(s) with a total capacity of 1.46 GW in 2020 and 2.91 GW in the year 2025.

In 2015 the countries with the highest share of nuclear power in their NGC (more than double the ENTSO-E average value) are France (with 51%), Slovakia (about 32%) and Belgium (26%). In 2020 the following countries are added to list of countries with a two times higher share of nuclear power plants in their total NGC than the ENTSO-E average , namely Czech Republic, Bulgaria, Finland, Lithuania, Slovenia and Sweden. The share of nuclear power plants in NGC in Belgium decrease to 17% in 2020 due to application of the existing nuclear phase out law. The Belgian government has however announced their intention to postpone the nuclear phase out by 10 years. These statements are illustrated in next figures (Figures 3.2.27 and 3.2.28).

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

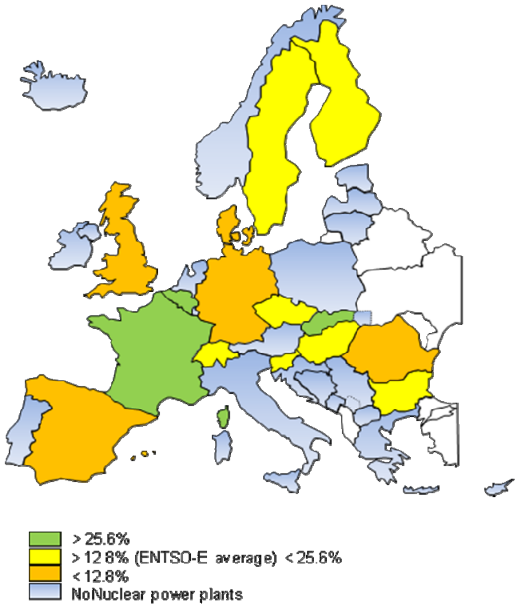


Figure 3.2.27: ENTSO-E Installed Capacity in nuclear power plants as a part of NGC per country; January 2015; 7 p.m.

Figure 3.2.28: ENTSO-E Installed Capacity in nuclear power plants as a part of NGC per country; January 2020; 7 p.m.

The commissioning/decommissioning of nuclear units is a very political sensitive issue. Therefore, this area will be almost certainly subjected to some changes in the future.

3.2.6 Reliably Available Capacity

Reliably Available Capacity (RAC) is Net Generating Capacity (NGC) without unavailable capacity. RAC is the part of NGC actually available to cover the load at a reference point. Unavailable Capacity is the part of NGC that is not reliably available to power plant operators due to limitations of the output of power plants.

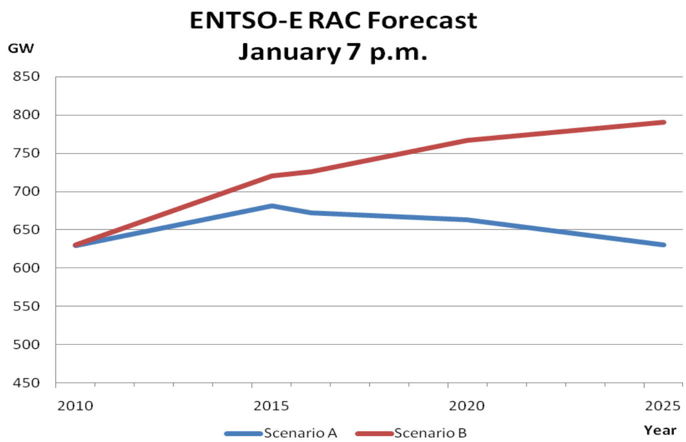


Figure 3.2.29: ENTSO-E Reliably Available Capacity Forecast

RAC increases up to 2015 in both scenarios (Figure 3.2.29). After this year in Scenario A this parameter starts to decrease due to the nature of this Scenario (a more pessimistic scenario, new generation development is not as ambitious as in Scenario B, which can be considered as a more "optimistic" scenario). In Scenario B, on the contrary, the RAC increases consistently due to a more optimistic view on generation development. The decrease between 2015 and 2016 in Scenario A or the reduced rate of development in Scenario B is probably influenced by the fossil fuels power plants decommissioning due to LCP Directive (see paragraph 3.2.2). This trend is the same for each reference point.

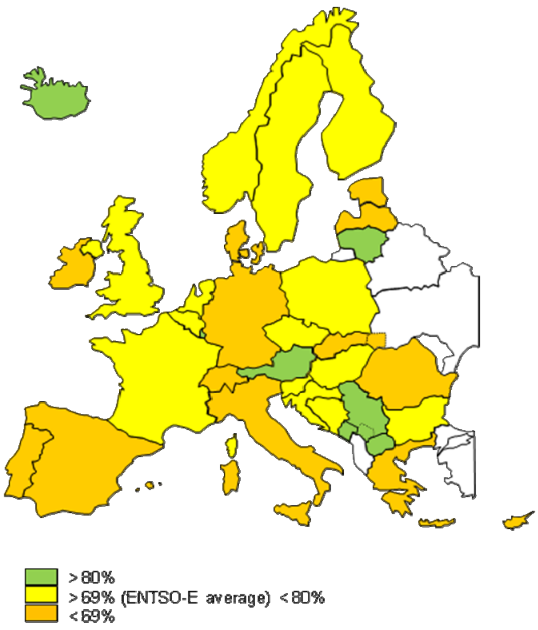


Figure 3.2.30: ENTSO-E Reliable Available Capacity as a part of NGC; January 2015; 7 p.m. Scenario B

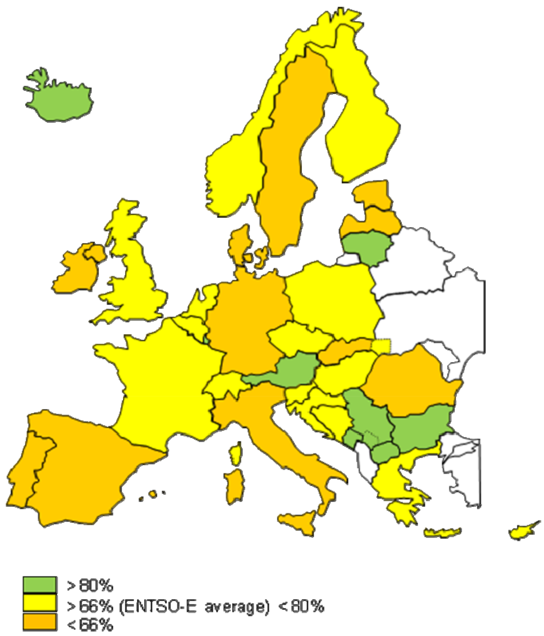


Figure 3.2.31: ENTSO-E Reliable Available Capacity as a part of NGC; January 2020; 7 p.m. Scenario B

Figures 3.2.30 and 3.2.31 show share of RAC as a part of NGC. The higher the percentage, the less unavailable capacity there is for that country to deal with. For example countries with high share of wind and solar power plants show smaller percentage compared to other countries.

Amount of unavailable capacity, on the other hand, is increasing in both scenarios and for each reference point. Up to 2025 (3rd Wednesday of January at 7 p.m.) the unavailable capacity increases by almost 127.9 GW (33.7%) in Scenario A and by 195.5 GW (43.7%). in Scenario B.

Comparison of the RAC and the Unavailable Capacity in Scenario B for the reference point (3rd Wednesday of January at 7 p.m.) is shown in the next figure (Figure 3.2.32) and in next table (Table 3.2.1). They also confirm previous conclusions about these parameters.

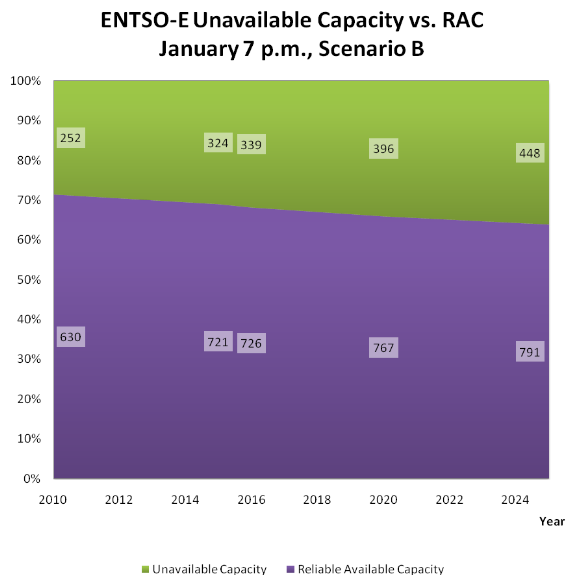


Figure 3.2.32: ENTSO-E Reliably Available Capacity vs. Unavailable Capacity as a part of NGC.

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

	2010	2015	2016	2020	2025
Unavailable Capacity	28.56%	31.01%	31.86%	34.08%	36.13%
Reliably Available Capacity	71.44%	68.99%	68.14%	65.92%	63.87%

Table 3.2.1: ENTSO-E Reliably Available Capacity and. Unavailable Capacity as a percentage of NGC; January 7 p.m., Scenario B

The percentages in the table above (Table 3.2.1) show that the later the year, the lower the percentage of RAC as a part of NGC. It means that amount of unavailable capacity is increasing, which is caused mainly by RES capacity (mainly wind; not considering hydro power plants) development. As a general conclusion one could say that only about 68% of NGC is transformed into RAC (on average).

The increase in Non-Usable Capacity is mainly responsible for the increase of unavailable capacity. From 2010 up to 2025 that increase is responsible for almost 53% of the increase in unavailable capacity. It is probably caused by the increasing part of wind power capacity of which a large part is considered as unavailable because of its stochastic nature. This unavailable part of wind installed capacity is therefore naturally counted as Non-Usable Capacity. However it should be borne in mind that power plants operators consider data on “non-usable capacity” as sensitive information in terms of competition. For this reason, detailed information about this parameter is problematic for system operators to obtain.

The second most increasing part of Unavailable Capacity is Maintenance and Overhauls. This parameter shows the biggest increase between 2010 and 2015 (about 6 GW). In the period after 2015 there is a decrease of about 1 GW (up to the 2016) and this is followed by an increase of about 1 GW up to the 2020 and about 1 GW again between 2020 and 2025. This almost stable state in the amount of capacity unavailable due to Maintenance/Overhauls could be connected either with the fact, that most of power plants operators plan Maintenance and Overhauls of their devices during the summer period or with the fact that RES units (excluding hydro) do not have such intensive requirements for this type of services (mainly off-shore wind farms).

Focusing on the 3rd Wednesday in July (at 11 a.m.) there is a visible significant increase in Maintenance and Overhauls after 2016 in almost all countries. The total increase of Maintenance and Overhauls for the whole ENTSO-E between 2010 and 2025 in summer (15 GW) is almost double compared to the total increase in winter (7.5 GW) over the same period. However, after 2020 the level of Maintenance for this reference point changes very little and almost at the same rate as in the winter reference points (about 1 GW). The increase in Maintenance and Overhauls in the period 2010-2025 is mainly observed in Germany, Great Britain and Italy for each reference point. More details can be found in the National comments section.

The Outages part of the Unavailable Capacity shows, compared with Non-usable Capacity, only an insignificant increase. During all investigated years, outages show only small changes (±2 GW). However, focusing on summer reference point, this parameter is increasing all the time (from 2010 up to 2025 by almost 4 GW). Furthermore, some countries have not reported any data for this part (e.g. Finland, Croatia or Lithuania) and thus this could influence the validity of the conclusion.

The Unavailable Capacity breakdown for January 7 p.m. in Scenario B is shown on the Figure 3.2.33.

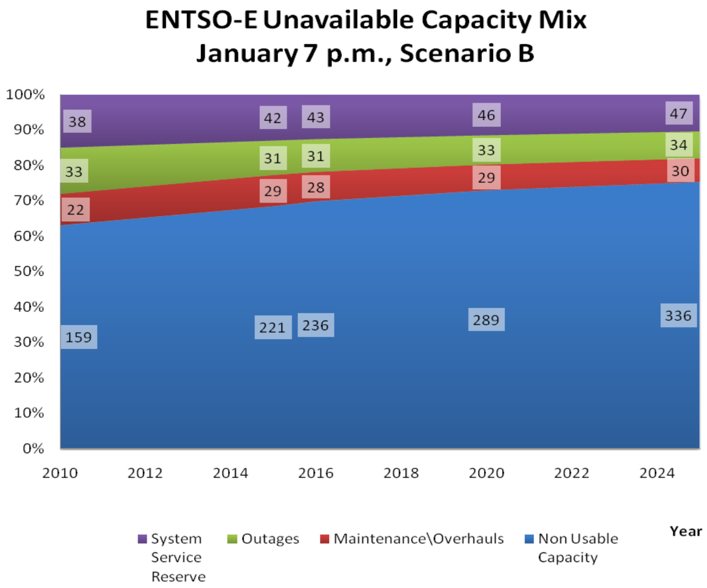


Figure 3.2.33: ENTSO-E Unavailable Capacity Mix

In Scenario B, the Unavailable capacity as a part of NGC is about 28.5% in 2010 and 36% in 2025 (in January 7 p.m.). This share is thus increasing during the whole monitored period as well as over other reference points.

System Services Reserve increases from 2010 to 2025 by 18.2%. It is very similar in all reference points in Scenario B. The main contributors are Germany, Italy and Slovenia.

For more comments see National section.

3.3 Generation Adequacy Forecast

3.3.1 Remaining Capacity

Remaining capacity in ENTSO-E is positive at each reference point and in both scenarios with quite similar evolutions. Only in scenario A in January 2025 at 7 p.m. are some quite low RC values expected (+1.7 GW). This time horizon is some way in the future and is influenced by high uncertainty concerning assumptions made by each TSO/national data correspondent. The next figure shows (Figure 3.3.1) the course of the RC.

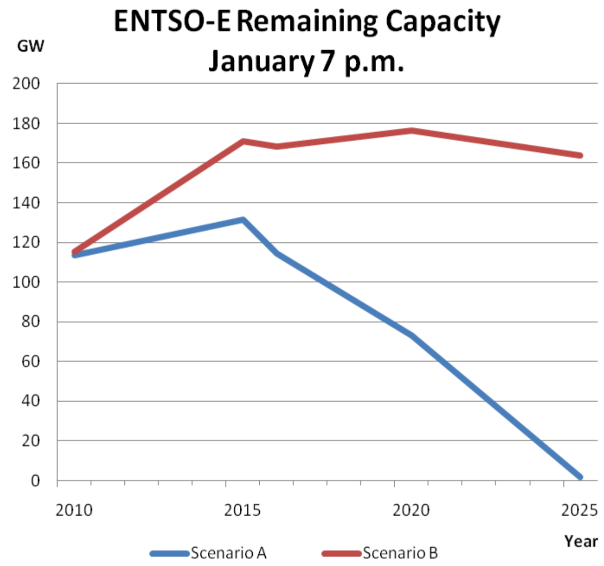


Figure 3.3.1: ENTSO-E Remaining Capacity forecast

Differences between Scenario A and Scenario B are given by their nature. In Scenario A much lower commissioning of new units is expected (scenario A only contains commissioning which is certain) with higher level of decommissioning of older units. On the contrary in Scenario B there is higher development of RES capacity (excluding hydro) and some kinds of fossil fuels expected, which influences the amount of RC. Countries with positive/negative Remaining Capacity in 2015 and 2020 are shown on Figures 3.3.2 and 3.3.3. In 2015 Finland and Latvia seem to be dependent on imports whereas, in the same year, Germany, Italy, Netherlands and Austria have sufficient available capacity (40.40 GW; 22.30 GW; 14 GW and 13.60 GW respectively). In 2020 only Denmark seems to be importing for security of supply reasons at the reference points, and among countries with enough capacity France (with 19.1GW) stands out.

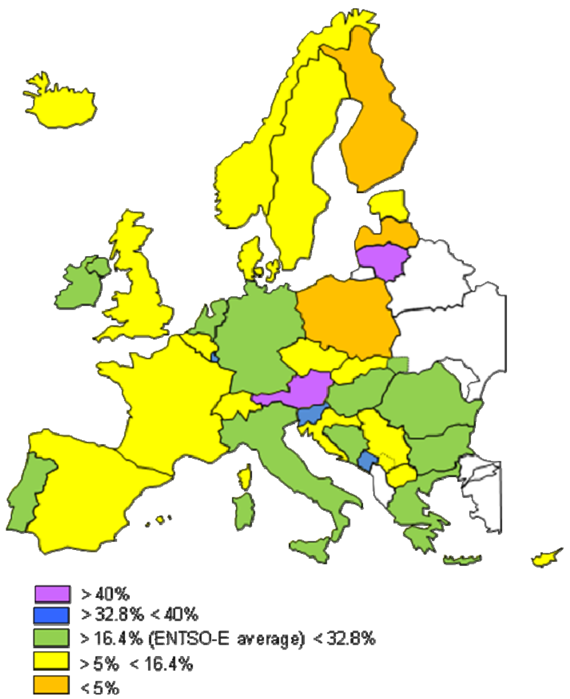


Figure 3.3.2: ENTSO-E Remaining Capacity as a part of Net Generating Capacity; January 2015; 7 p.m. Scenario B

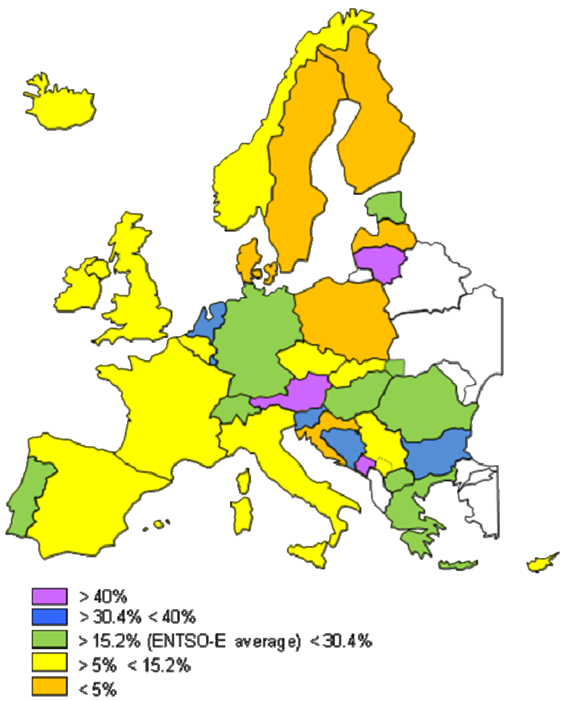


Figure 3.3.3: ENTSO-E Remaining Capacity as a part of Net Generating Capacity; January 2020; 7 p.m. Scenario B

Although wind installed capacity will increase significantly, most of the RC will result from Fossil Fuels capacity. The increase in Fossil Fuels capacity forecast is mainly driven by a bottom up approach based on real projects. After 2015 TSOs have less and less information on new projects coming in probably resulting in stabilisation of RC in this time period.

3.3.2 Remaining Capacity vs. Adequacy Reference Margin

Considering the criteria of generation adequacy assessment, these say:

“When Remaining Capacity is over or equal to Adequacy Reference Margin, it means that some spare generating capacity is likely to be available for export on the power system”

“When Remaining Capacity is lower than Adequacy Reference Margin, it means that the power system is likely to have to rely on import flows when facing severe conditions”[18]*;*

The generation adequacy within the whole ENTSO-E system in Scenario B should be maintained during all monitored periods in each reference point (not taking into account possible transport capacity limitations between countries and/or regions).

In Scenario A, generation adequacy should be maintained until 2020. After this year, new generation capacity could be needed in January over both reference points to achieve at least today’s levels of adequacy (not taking into account possible transport capacity limitations between countries and/or regions). For July, this situation occurs after 2020 (around 2022).

As the lowest level of ARM occurs in January at 7 p.m., focusing only on this reference point, there will be a need for about 124 GW of additional RC in 2025 in Scenario A in order to achieve at least today´s level of adequacy. It means thus 124 GW in RAC. However, when considering that only 64% of NGC will result in Reliably Available Capacity[19] there will be a need for about 193 GW of additional new generation capacity that is not yet decided today.

In Scenario B, generation adequacy is maintained at all the times for any reference point. For 2025, January, 7 p.m., the difference between RC and ARM is for 24 GW higher than the same difference for the current situation. Thus it means 24 GW in RAC, i.e. there is surplus of generation capacity about 37.4 GW (see also the previous paragraph).

The situation is illustrated on the figures below (Figures 3.3.4, 3.3.5 and 3.3.6).

[18] *See also the Chapter 2.3 Methodology*

[19] *See chapter 3.2.6; 64% was used as an percentage for the year 2025*

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

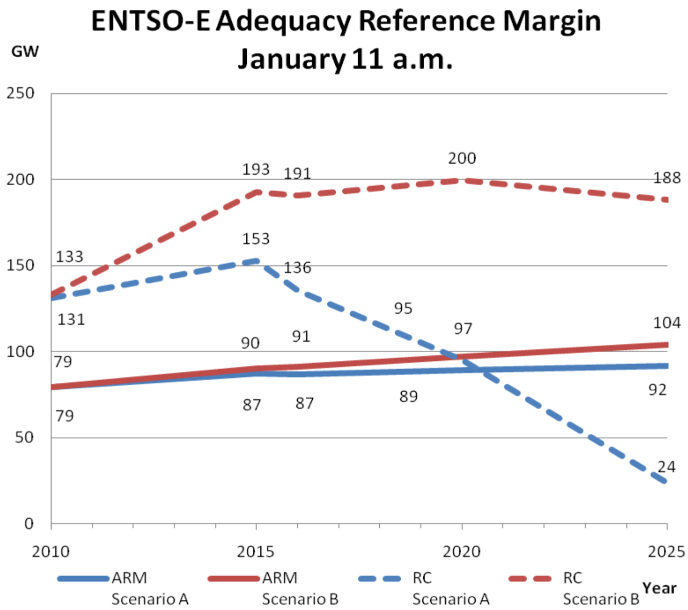


Figure 3.3.4: ENTSO-E Generation adequacy forecast

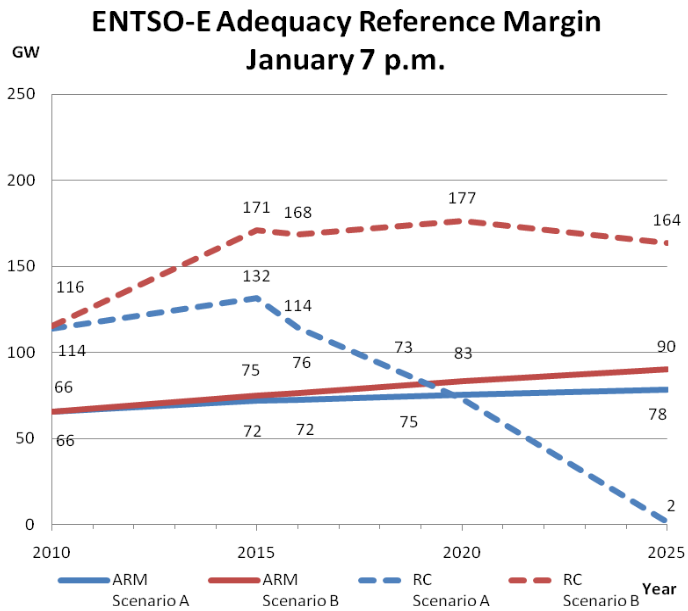


Figure 3.3.5: ENTSO-E Generation adequacy forecast

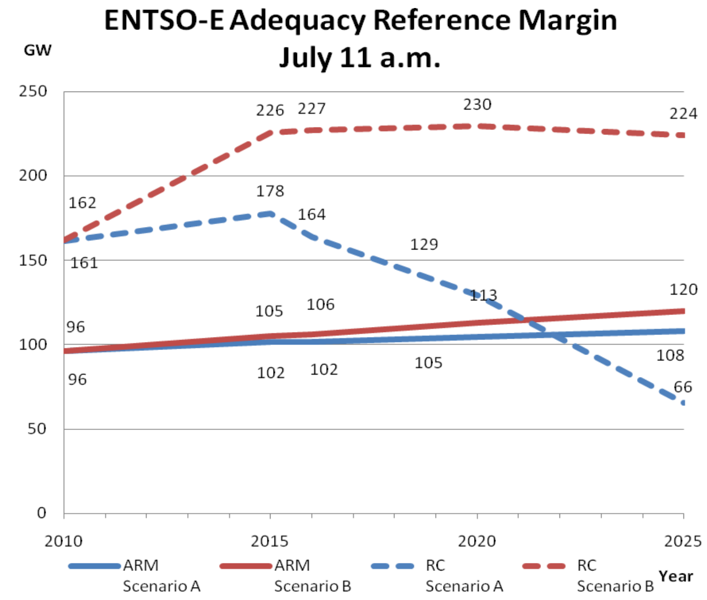


Figure 3.3.6: ENTSO-E Generation adequacy forecast

The situation in each ENTSO-E member state is illustrated on the maps below (Figures 3.3.7 and 3.3.8). In 2015 countries with remaining capacity under ARM are Cyprus (-17%), Finland (-7%), Croatia (-5%), Latvia (-8%), Former Yugoslavian Republic of Macedonia (-11%), Poland (-7%) and Republic of Serbia (-1%). In 2020 the situation will improve (i.e. RC will be above ARM) in Finland (+1%), Latvia (+6%), Former Yugoslavian Republic of Macedonia (+10%) and Republic of Serbia (+1%) however in Belgium (-1%), Denmark (-21%), Iceland (-3%) the situation is worse compared to 2015. Note that at national level not all TSOs/national data correspondents consider Spare Capacity. It is namely Slovakia, Latvia, Luxembourg, Montenegro, Finland, Norway, Denmark and the Netherlands (for more details see national comments section).

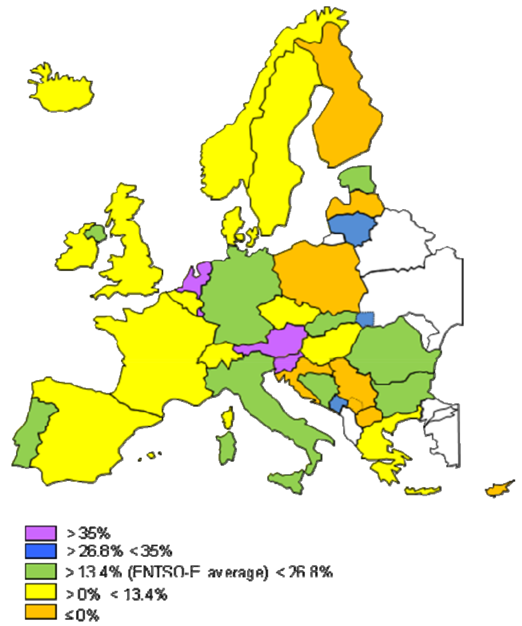


Figure 3.3.7: Remaining Capacity minus Adequacy Reference Margin as a part of Reliably Available Capacity per country; January 2015; 7 p.m. Scenario B

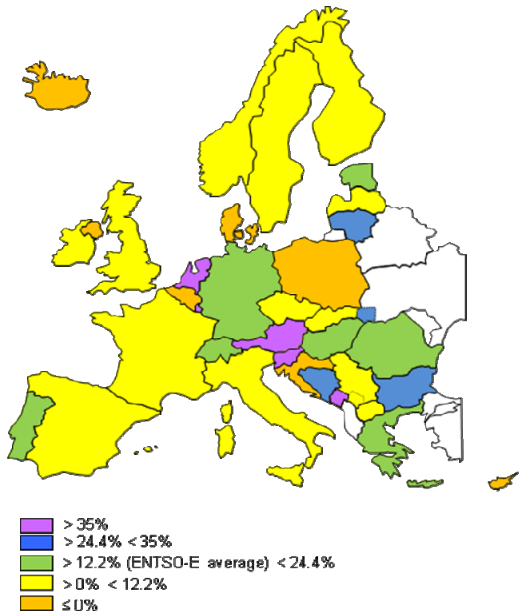


Figure 3.3.8: Remaining Capacity minus Adequacy Reference Margin as a part of Reliably Available Capacity per country; January 2020; 7 p.m. Scenario B

Not all TSOs/national data correspondents consider ARM or not all of them have provided this data within SAF data collection process. In future SAF reports the emphasis should probably be laid on better explaining what this parameter means, because some TSOs/national data correspondents might have some difficulty with its interpretation. More detailed information could be found in the national section.

4. Regional Adequacy Section

This section includes a regional adequacy assessment for each individual Regional Group (hereinafter only "RG") under ENTSO-E System Development Committee. Although in this ENTSO-E SAF Report the Generation adequacy is analysed primarily at whole ENTSO-E level or individual level, some regional specifics are reported in this chapter. The assessment is based on Remaining Capacity minus Adequacy Reference Margin criterion evaluation for each individual country within the RG concerned. I.e. it is adequacy assessment in most of situations and is primarily focused on the year 2020 and on each reference point (unless otherwise indicated).

However, it should be noted that not all TSOs/national data correspondents consider ARM (see paragraph 3.3.2).

Regional adequacy assessments are also given in Chapter 6 (Role of Interconnectors), where more detailed remarks about problem regions are analysed, i.e. regions where some load seems to be covered by imports of electricity from neighbouring countries. In the following SAF Report more attention will be given to the regional adequacy assessment after adapting the methodology for regions.

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

4.1 Regional Group North Sea

The Remaining Capacity is forecasted to be higher than the Adequacy Reference Margin for the Regional Group North Sea (Belgium, Denmark, Germany, Great Britain, France, Republic of Ireland, Northern Ireland and Norway) from now on to 2025 at all reference points.

This regional extra capacity is the lowest at the reference point July 11 a.m. (summer peak load) in 2010 and 2020. In all other studied years the lowest additional capacity is projected for the reference point January 7 p.m. (winter peak load). The additional capacity is projected to increase for the summer reference point from 27 GW in 2010 to 60.5 GW in 2015. Between 2015 and 2016 a small decrease of 1.6 GW is foreseen. This decrease is foreseen to go on between 2016 and 2020, resulting in an additional capacity of 45.9 GW in 2020. Finally an additional capacity of 39.7 GW is predicted for 2025. The Remaining Capacity minus Adequacy Reference Margin in the Regional Group North Sea is foreseen to increase with 26% (7.3 GW) for the summer peak and 47% (12.7 GW) for the winter peak in the period 2010-2025. For this period Germany and The Netherlands report increases of respectively 251% (13.3 GW) and 241% (9.4 GW) for the winter peak and respectively 143% (11.9 GW) and 196% (9.4 GW) for the summer peak. The additional capacity available in Germany and the Netherlands is higher than the simultaneous export capacity reported for these countries.

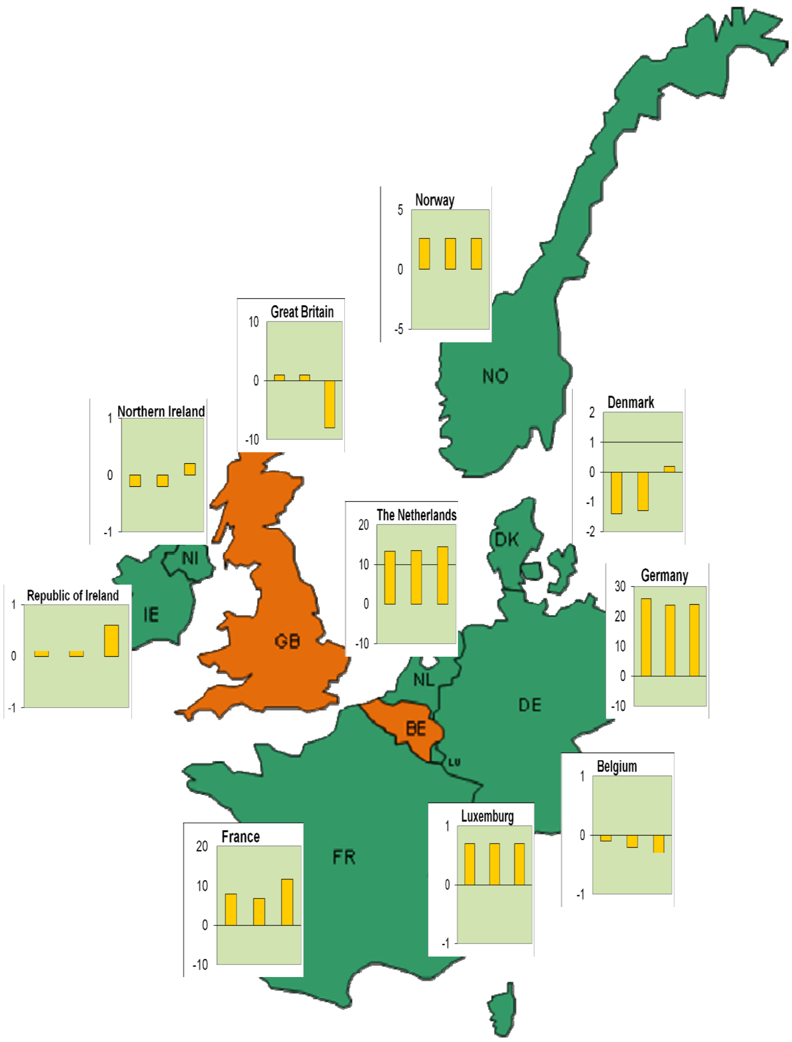


Figure 4.1.1: Remaining capacity minus Adequacy Reference Margin for each country in RG NS in 2020 (Scenario B)

The colours displayed in the map above illustrate the worst situation for the Remaining Capacity minus the Adequacy Remaining Margin (RC-ARM) for each country in the Regional Group North Sea in 2020 (RED if RC-ARM is negative and GREEN if RC-ARM is positive), namely at the reference point July 11 a.m. The small bar charts show the national values at all 3 reference points in 2020.

The regional assessment for the Regional Group North Sea indicates that if no constraints occur on the transmission network, some generating capacity should be available for exports out of the Regional Group North Sea, in all time horizons and at all reference times. However, some countries within the Regional Group North Sea may depend on import under certain conditions. For the summer period 2010 the RC-ARM for Great Britain is negative. In 2015 all individual countries have a positive assessment for the RC-ARM criterion. The RC-ARM becomes negative for Belgium from 2016 on for all reference points. Denmark has a negative assessment for the RC-ARM criterion for the winter period in 2016 and for all reference points from 2020 on. From 2020 on the RC-ARM assessment becomes negative for Northern Ireland for the winter reference points. In 2020 RC-ARM becomes again negative in Great Britain for the summer period (-8 GW). In 2025 the assessment becomes also negative in Great Britain for the reference points for the winter period. However, the dependency on import is predicated to be higher for the summer period. Furthermore in 2020 as well as in 2025 the negative capacity resulting from the RC-ARM analyses is higher than the reported simultaneous import capacity for Great Britain.

.

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

4.2 Regional Group Baltic Sea

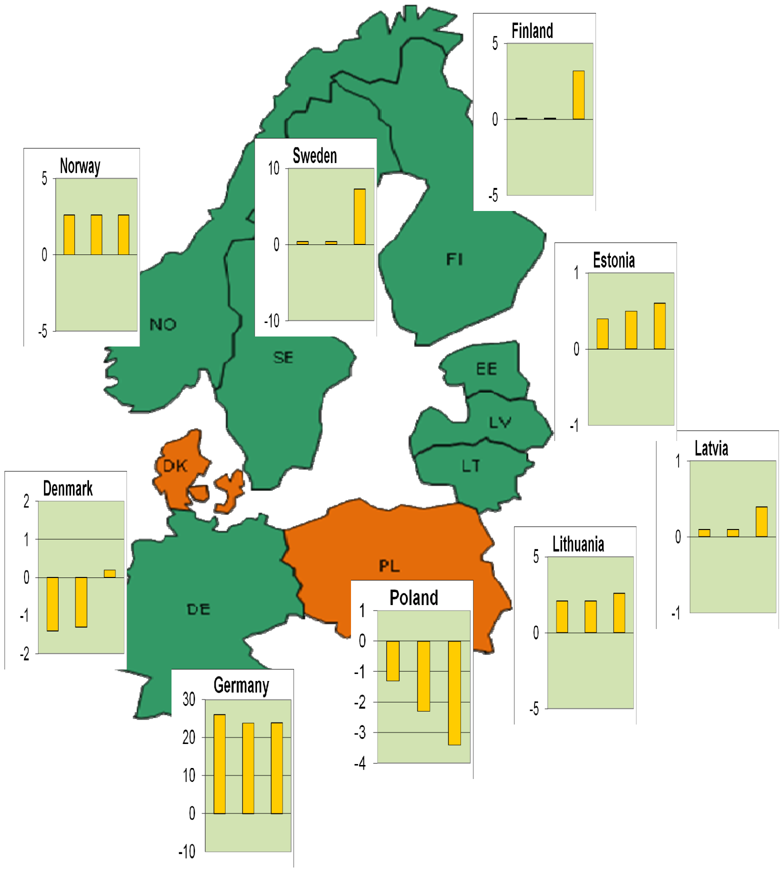


Figure 4.2.1: Remaining capacity minus Adequacy Reference Margin for each country in RG BS in 2020 (Scenario B)

The power balance is generally expected to be good in the Baltic Sea region. Most countries expect positive values for the indicator Remaining Capacity minus Adequacy Reference Margin. In 2020, Denmark is expected to have a negative RC-ARM value, as a result of large and increasing proportion of the power production from wind, which is not included in the power balance. This power deficit will be covered either by domestic wind power production if it is windy or through import from neighbouring countries - typically hydro power from Norway and Sweden. Such as situation is a typical example of the synergies between different types of renewable energy sources connected by a strong transmission system. Notably in the Nordic area, it has been demonstrated over a long period of time how hydro and wind power have been able to complement each other as a result of the transmission system which makes significant power flows possible.

4.3 Regional Group Continental South West

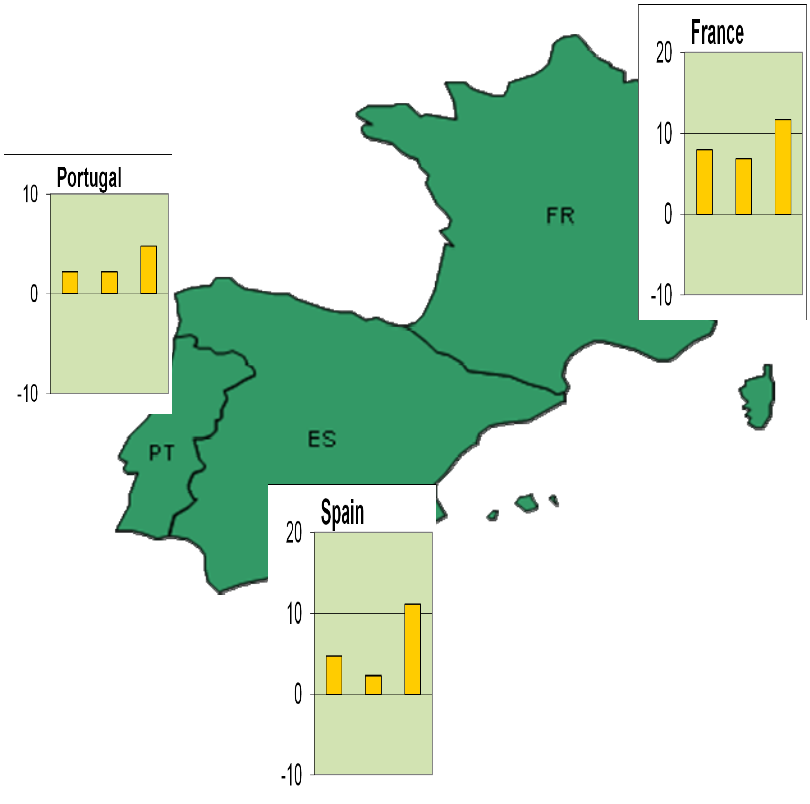


Figure 4.3.1: Remaining capacity minus Adequacy Reference Margin for each country in RG CSW in 2020 (Scenario B)

In the Regional Group South West (France, Portugal and Spain) Remaining Capacity is expected to be always higher than the Adequacy Remaining Margin during the analysed period in best estimate Scenario B.

Should no constraints occur in the transmission network, the overall capacity that can be potentially exported to other regions (i.e. that result is expected to remain always above 5.9 GW during 2010-2025). Since annual peak load is observed during winter period for the 3 countries, exportable capacity is particularly high during summer reference point.

The colours displayed in the map above (RED if RC-ARM is negative and GREEN if RC-ARM is positive) illustrate the worst situation for each country in the Regional Group South West, in 2020. Small bar charts show the national values at all 3 reference points in 2020 (11 a.m. January, 7 p.m. January and 11 a.m. July, respectively).

As can be observed, in 2020, there is extra capacity under worst situation, which is expected to happen during January, at 7 p.m. reference time (second bar in the charts). At this moment, overall extra capacity reaches nearly 11.5 GW.

More details can be found in the national comments section.

4.4 Regional Group Continental South East

The Remaining Capacity is forecasted to be higher than the Adequacy Reference Margin for the Regional Group South East (Bosnia-Herzegovina, Bulgaria, Croatia, Former Yugoslavian Republic of Macedonia (MK), Greece, Hungary, Italy, Montenegro, Romania, Serbia and Slovenia) from now on to 2025 at all reference points.

In all the studied years, this regional extra capacity is projected to be lowest at the reference point January 7 p.m. (winter peak load), while the absolute lowest additional capacity appears at reference point January 7 p.m. of 2020. Should no constraints occur in the transmission network, the overall capacity that can be potentially exported to other regions (i.e. that result is expected to remain always above 8.5 GW during 2010-2025.

The colours displayed in the map below illustrate the worst situation for the Remaining Capacity minus the Adequacy Remaining Margin (RC- ARM) for each country in the Regional Group South East in 2020 (RED if RC-ARM is negative and GREEN if RC-ARM is positive), namely at the reference point January 7 p.m. The small bar charts show the national values at all 3 reference points in 2020 (January at 11 a.m., January at 7 p.m. and July at 11 a.m., respectively).

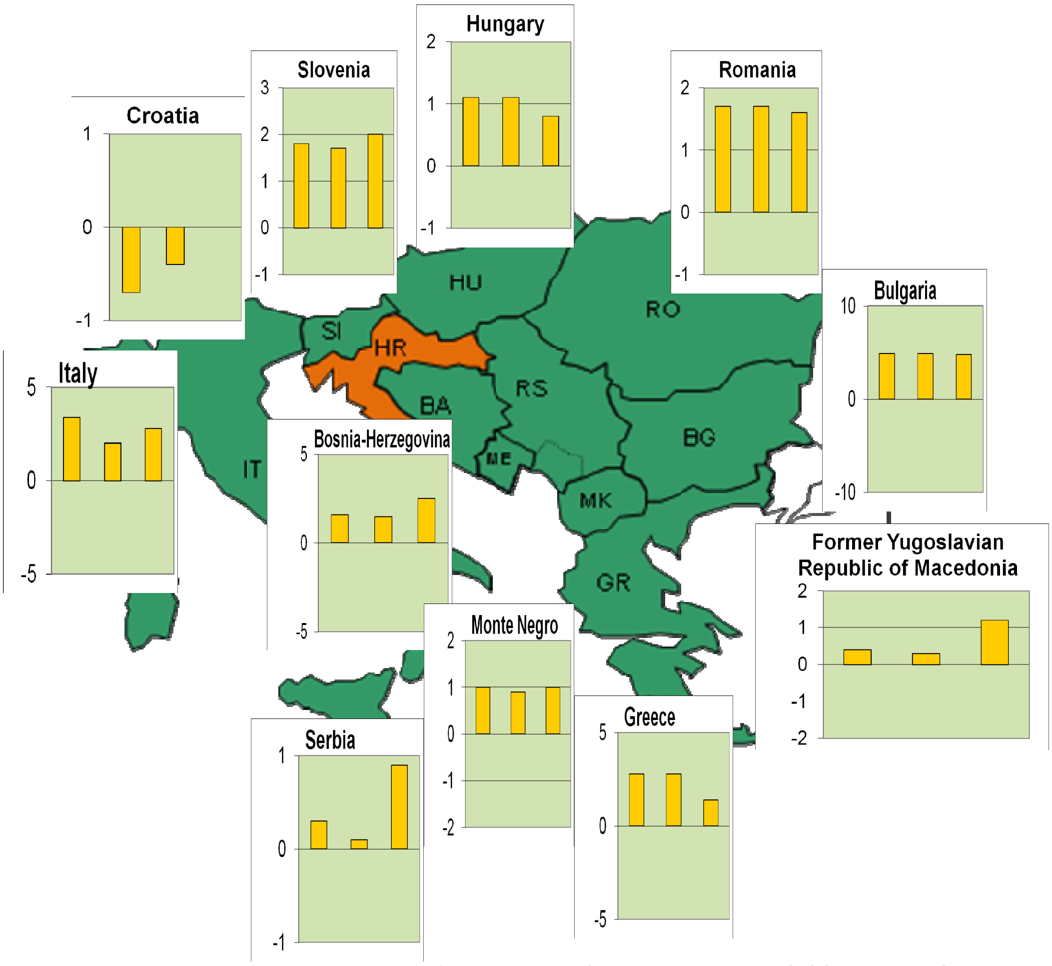


Figure 4.4.1: Remaining capacity minus Adequacy Reference Margin for each country in RG CSE in 2020 (Scenario B)

As can be observed, in 2020, there is extra capacity under worst situation, which is expected to happen during January, at 7 p.m. reference time (second bar in the charts). At this moment, overall extra capacity reaches nearly 16.6 GW. Furthermore, it can be seen that in 2020, all countries in the Regional Group South East have a positive assessment for the RC-ARM criterion for all reference points, with the exception of Croatia.

Most countries of the Regional Group South East (Bosnia-Herzegovina, Bulgaria, Greece, Montenegro, Romania and Slovenia) have a positive assessment for the RC-ARM criterion for all reference points from 2015 and on. Hungary, Italy and Serbia have a positive assessment for the RC-ARM criterion for all reference points from 2015 and on, except for the year 2025. More specifically, RC-ARM becomes negative for Hungary on the summer reference point, for Italy on all reference points and for Serbia in both winter reference points. Croatia has a negative assessment for the RC-ARM criterion for the winter period and a positive assessment for the summer period of all study years. Former Yugoslavian Republic of Macedonia (MK) has a negative assessment for the RC-ARM criterion for the winter period up to 2016 and a positive assessment for all other reference points.

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

4.5 Regional Group Continental Centre South

In the Regional Group Continental Centre South as a whole, Remaining Capacity is foreseen as higher than the Adequacy Remaining Margin from now on to 2025 at all reference points.

This regional extra capacity is minimal at the reference point January 7 p.m. (winter peak load), as it is in each individual country in the Regional Group. It should increase at that reference point from about 29 GW in 2010 to 94 GW in 2020 and later decrease but still positive.

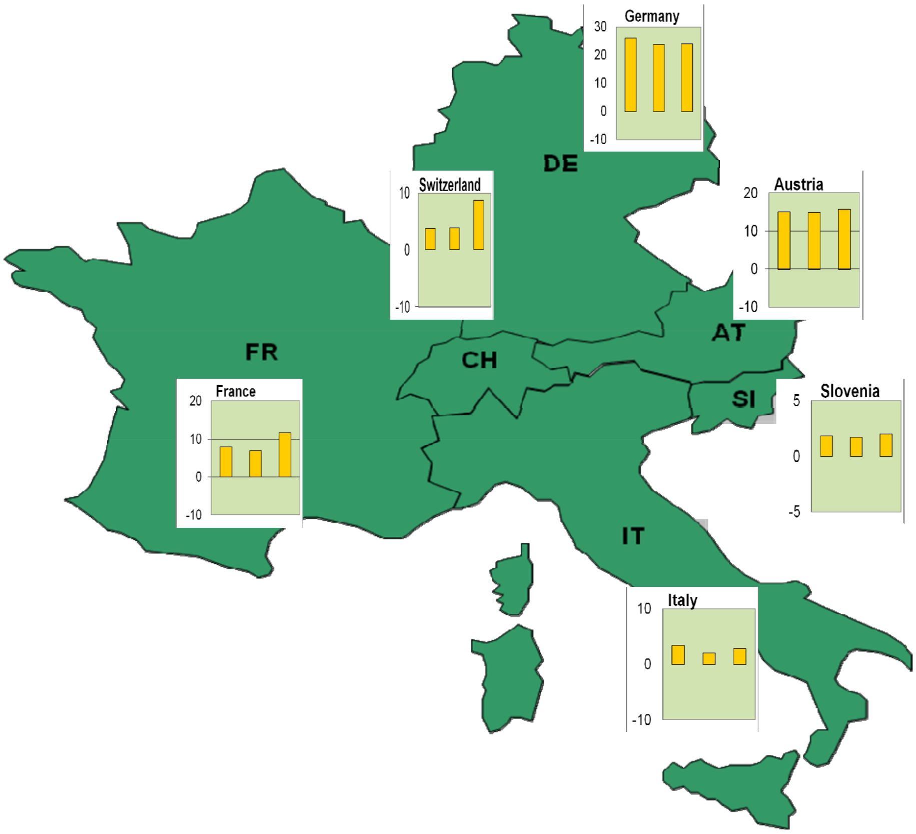


Figure 4.5.1: Remaining capacity minus Adequacy Reference Margin for each country in RG CCS in 2020 (Scenario B)

The map below displays the Remaining Capacity minus the Adequacy Remaining Margin for each country in the Regional Group Continental Centre South in 2020 at reference point January 7 p.m. Small bar charts show the national values at all 3 reference points in 2020.

The analysis of this result is that, should no constraints appear on the transmission network, some generating capacity should be available for exports out of the Regional Group, in all time horizons and at all reference times. It is in fact the case in each individual country at all time horizons, with the remarkable exception of Italy in winter 2025. Indeed, Italy is the only country where a major drop is foreseen, later than 2016. Meanwhile the values should triple from 2010 to 2025 in Germany and Austria. More details can be found in the national comments. On a regional basis, such an unbalanced evolution should increase the role of the cross-border transmission lines with Italy in the future.

4.6 Regional Group Continental Centre East

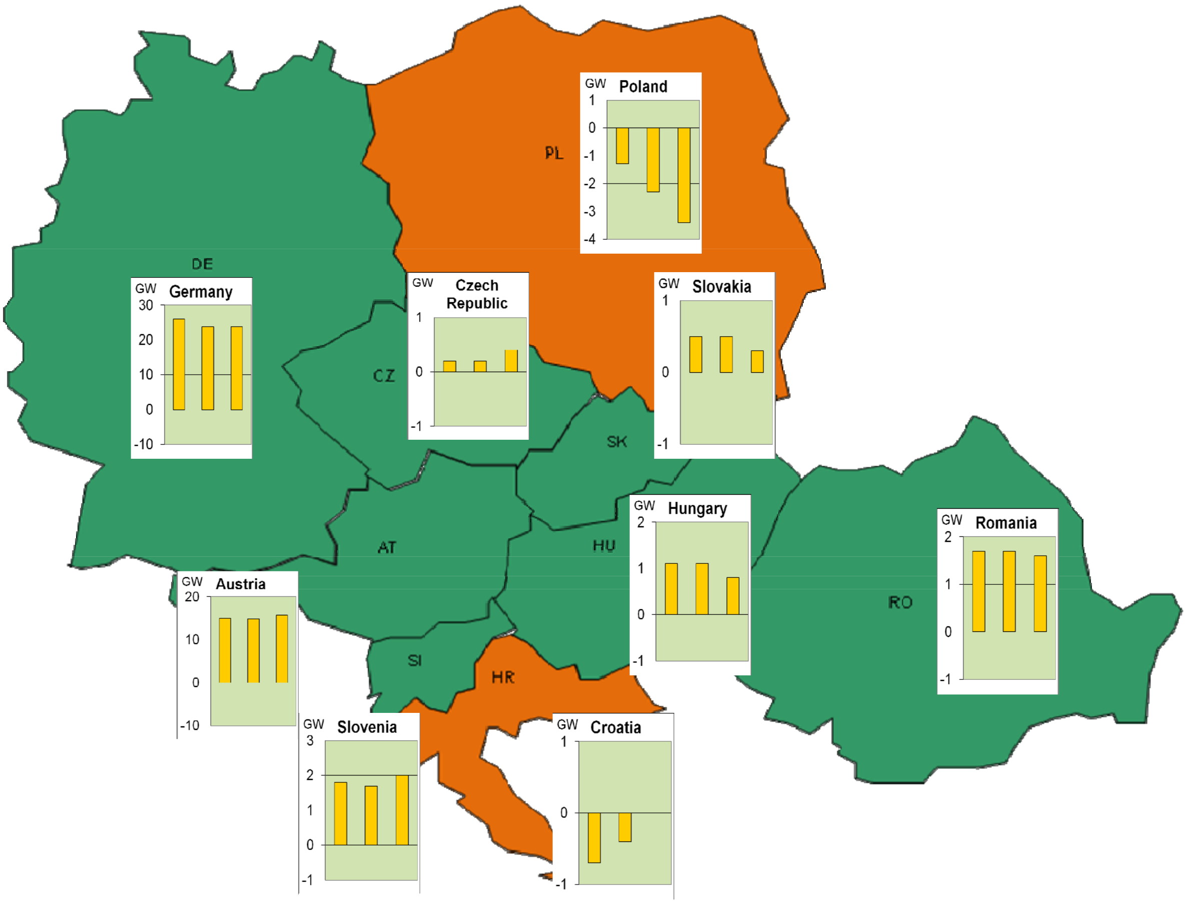


Figure 4.6.1: Remaining capacity minus Adequacy Reference Margin for each country in RG CCE in 2020 (Scenario B)

Generation Adequacy assessment for ENTSO-E region Continental Central East in 2020 for all reference points (3rd Wednesday in January at 11 a.m. and at 7 p.m., 3rd Wednesday in July at 11 a.m.) is depicted in the Figure 4.6.1. It is assessment of regional generation adequacy in most of situations, i.e. the comparison between Remaining Capacity and Adequacy Reference Margin. When RC minus ARM is negative, it means that some capacity will be needed in monitored period and has to be imported. When RC minus ARM is positive it is considered as an extra capacity which could be potentially exported.

In the CCE region there are most of countries with positive RC-ARM in monitored year. Only Croatia and Poland are likely to be depending on imports from their neighbours. In five countries the situation is worst in summer period (Poland, Slovakia, Hungary, Romania, and Germany) and in the rest of countries is the worst situation in winter period.

Focusing on whole CCE region in 2020 the RC is higher than ARM in all reference points.

In 2015 is the situation slightly better in whole CCE region. Only one exception is Hungary, where the situation from 2015 to 2020 doesn´t changes significantly and remains almost the same.

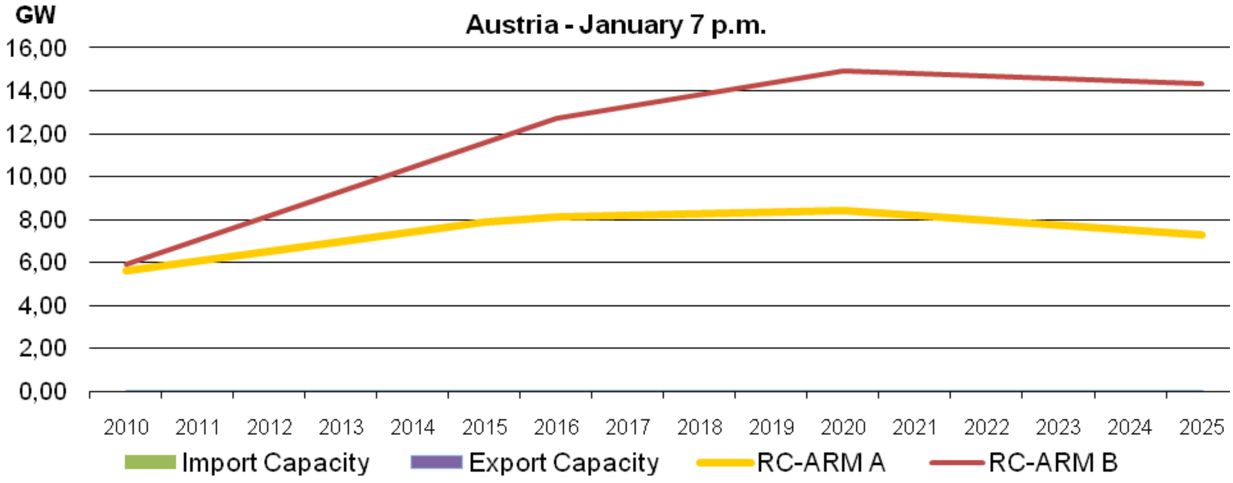
5. National Adequacy Section

This section is dedicated to the analysis of individual countries. It contains a chart of the adequacy forecast for the 3rd Wednesday of January at 7 p.m. for each country and the national comments provided with the data by the respective TSO/national data correspondent.

Abbreviation	Country / Area	Contact:
AT	Austria	ernst.reittinger-hubmer@verbund.at
BA	Bosnia Herzegovina	s.hadzic@nosbih.ba
BE	Belgium	viviane.illegems@elia.be
BG	Bulgaria	georgiev@ndc.bg
CH	Switzerland	alexander.mondovic@swissgrid.ch
CY	Cyprus	chadjilaou@dsm.org.cy
CZ	The Czech Republic	fantik@ceps.cz
DE	Germany	bernd.wegner@bdew.de
DK	Denmark	stw@energinet.dk
EE	Estonia	izabella.knos@elering.ee
ES	Spain	rlopezsanz@ree.es
FI	Finland	hannu.maula@fingrid.fi
FR	France	nicolas.kitten@rte-france.com
GB	United Kingdom	steven.thompson@uk.ngrid.com
NI	Northern Ireland	raymond.skillen@soni.ltd.uk
GR	Greece	ktsirekis@desmie.gr
HR	Croatia	sasa.cazin@hep.hr
HU	Hungary	galambos@mavir.hu
IE	Ireland	philip.odonnell@eirgrid.com
IS	Iceland	magnip@landsnet.is
IT	Italy	andrea.lupi@terna.it
LT	Lithuania	vaida.tamasauskaite@lpc.lt
LU	Luxembourg	roby.gengler@creos.net
LV	Latvia	andrejs.eglitis@latvenergo.lv
ME	Montenegro	dragomir.svrkota@tso-epcg.com
MK	Former Yugoslavian Republic of Macedonia	izabelan@mepso.com.mk
NL	The Netherlands	e.pelgrum@tennet.org
NO	Norway	ane.elgesem@statnett.no
PL	Poland	lukasz.jezynski@pse-operator.pl
PT	Portugal	ricardo.pereira@ren.pt
RO	Romania	cristian.radoi@transelectrica.ro
RS	Serbia	jadranka.janjanin@ems.rs
SE	Sweden	mari.jakobsson@svk.se
SI	Slovenia	ervin.planinc@eles.si
SK	Slovak Republic	zeman_filip@sepsas.sk
UA-W	West Ukraine	saluk@wps.com.ua

This chapter should also serve as base for the evaluation of regional adequacy, i.e. a tool for the assessment of the role of the transmission capacities in problem regions (where some load seems to be covered by imports of electricity).

5.1 AT – Austria



All Austrian data are calculated for average climate and economic developments in the coming years.

Detailed information is described in "Masterplan 2009-2020" published by Verbund APG 2009. See English version:

http://www.verbund.at/cps/rde/xbcr/SID-4C609703-4CC64F87/internet/VBD_Masterplan_Kurzfassung_Engl.pdf

Generating capacity

Generally many new power plants are planned in Austria. Calculations for Scenario B are based on data collected for the "Masterplan 2009-2020" (Verbund APG 2009).

Load

As load is highly correlated to the economic development (GNP) it is assumed that 2010 and onward Austria will have a lower increase of GNP (1,5%) as before the financial crisis. This figure can change due to the development of the crisis.

Generation adequacy

Based on the development of load and generation capacity the overall generation adequacy will increase or at least be stable.

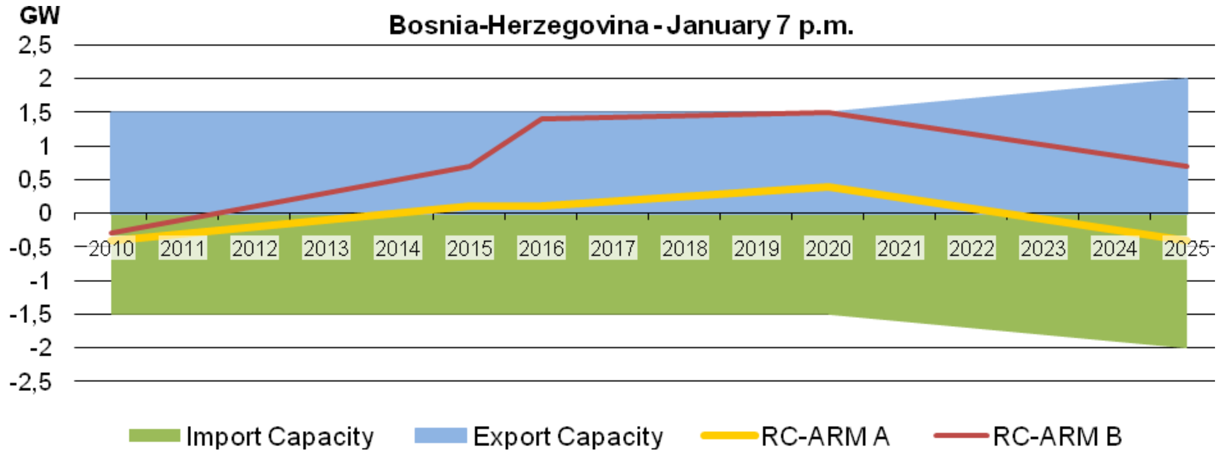
Interconnection Capacity

As a consequence of the development of load and generation capacity the following interconnection projects where identified as a subset of the "Master Plan projects" (see "Masterplan 2009-2020"[20]):

- Installation of the 2nd system to Hungary and integration of wind power in Burgenland
- Grid reinforcement to Germany

[20] *http://www.verbund.at/cps/rde/xbcr/SID-4C609703-4CC64F87/internet/VBD_Masterplan_Kurzfassung_Engl.pdf*

5.2 BA – Bosnia-Herzegovina



Generating capacity

"Production Development Indicative Plan" is a document announced by ISO BH, and it is taken as the base for the Conservative scenario A. According to this document, in the period 2010-2020 there are three new thermal power plants:

- TPP Stanari, 420 MW installed,
- TPP Tuzla, unit 7, 450 MW installed,
- TPP Kakanj (unit 8), 300 MW installed.

There are plans for several new hydro power plants with whole capacity about 300 MW and several wind farms with the whole capacity about 485 MW.

Load

No comments provided.

Generation adequacy

During the years 2010 and 2012 a revitalization of two TPPs is planned with installed capacity 300 MW installed. In the years 2013 and 2017 two TPPs with total installed power 300 MW will be put out of work.

Interconnection Capacity

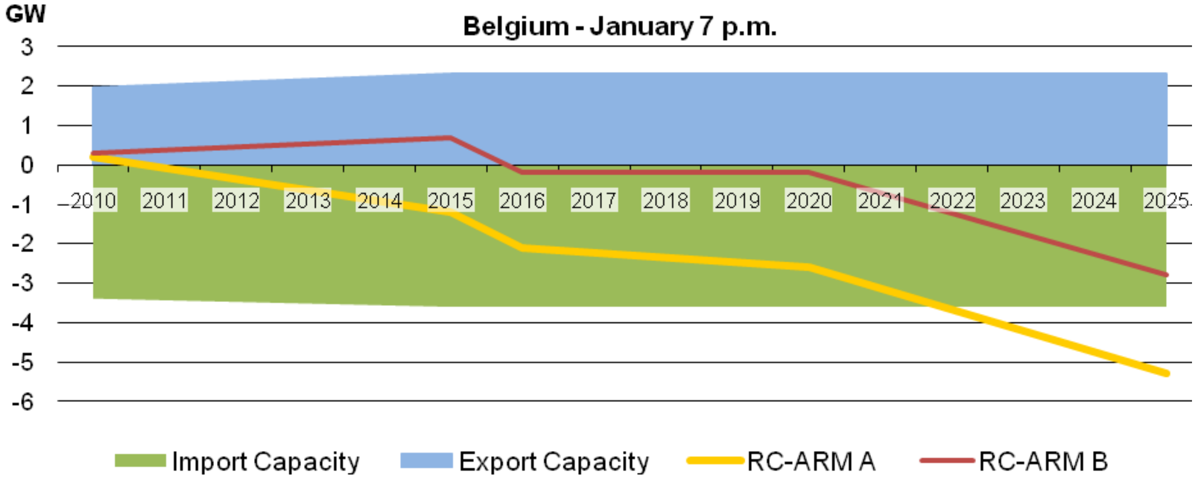
According to the plans of the new production facilities, especially in the case that Scenario B (best estimate scenario) happens, Bosnia and Herzegovina will be a significant exporter of electricity after the year 2015. This could not be possible without the new interconnection lines. There are two 400 kV new interconnections as an idea:

- Bosnia-Herzegovina – Croatia, New 400 kV interconnection between Bosnia-Herzegovina and Croatia is under consideration depending on power plants projects realization in both countries.
- Bosnia-Herzegovina - Montenegro (Visegrad - Pljevlja).

There doesn´t exist any preliminary study for these interconnections and any official compliance of neighbouring TSO. These interconnections would increase security of supply in all three countries and also capacities for transit and across border market.

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

5.3 BE – Belgium



The Belgian figures refer to Belgian territory and reflect the Belgian national figures (including all voltage levels in Belgium). Furthermore, the reference point for the load figures is based on real measurements that were supplemented by estimates to ensure 100% representativeness.

Generating capacity

The two reported generation capacity scenarios were constructed in September 2009. Both scenarios take into consideration the Belgian nuclear phase-out law as enforced at that moment, namely nuclear units are decommissioned after 40 years.

The installed generation capacity of centralized power stations in scenario A (conservative generation scenario) is obtained by using information from specific confirmed projects notably, projects that have obtained a generation license from the Ministry of Energy (up to the 15th of October 2009) as well as information regarding decommissioning that is derived from laws, directives, information given by generation companies or theoretical maximum lifetimes (The applied theoretical lifetimes per technology is based on the guidelines proposed by UCTE System Adequacy subgroup. However an additional 5 years was added to the theoretical lifetime of each technology. The following theoretical maximum lifetimes were assumed: coal units 45 years, OCGTs, CCGTs and diesels 35 years, gas turbines 40 years and turbojets 45 years). In scenario B (best estimate generation scenario) the specific confirmed new power units are complemented with additional coal base load capacity based on a not decided project to compensate for the nuclear phase out. Furthermore only information derived from laws, directives or input given by generators was used to estimate the decommissioning of power units in the studied period. The increase in decentralized generation capacity is based on a similar methodology. Specific projects announced to the TSO and DSOs are added to the installed generation capacity in both scenarios. The amount of renewable energy sources in 2020 is based on the installed generation capacity of renewable energy sources that is given in the 20/20 target scenario of the working paper 21-08 “Impact of the EU Energy and Climate Package on the Belgian energy system and economy - Study commissioned by the Belgian federal and three regional authorities” of the Belgian Federal Planning Bureau, with the exception of the installed capacity of solar panels. The installed capacity of solar panels is based on the results of a study made by Immoquest in June 2008. The level of renewable energy sources in 2025 was obtained by an extrapolation of the values of 2020.

As stated before, the implementation of the nuclear phase-out is taken into consideration in both scenarios as enforced end September 2009. Today a revision of this law is currently under discussion in Belgium and a postponement of 10 year of the nuclear phase out is very probable. An adaptation of the existing law concerning the nuclear phase out will result in a different best estimate and conservative scenario.

For this forecast 2010-2025, 9 fossil units previously (forecast 2009-2020) assigned as mixed fossil fuel units were reallocated to other fossil fuels. Three units were assigned to coal and 6 units to gas.

Load

The winter load values for 2010 are the historic values of the 3rd Wednesday of January 2009 respectively at 11 a.m. -7 p.m. augmented by the Belgian electricity growth rate of 2009/2010 in order to simulate the future values of 2010 (the same methodology was used for the load values of the years 2015, 2016, 2020 and 2025). The summer load value for 2010 is the historic value of the 3rd Wednesday of July 2008 at 11 a.m. - augmented by the Belgian electricity growth rate of 2008/2009 and 2009/2010 in order to simulate the future values of 2010 (the same methodology was used for the load values of the years 2015, 2016, 2020 and 2025). The historic value of the 3rd Wednesday of July 2009 was not used because this value is considered as an outlier not suited to be used as starting point for future tendencies.

The winter peak load for 2010, 2015, 2016, 2020 and 2025 is obtained by aggregation of the forecasts of individual loads at the different nodes of the transmission grid for those years at the peak moment. To obtain the summer peak load historic maximum values of the summer 2008 (quarter three and four) was combined with the average annual energy consumption growth rate. This methodology results in slightly increasing margin against seasonal peak load over the period 2010-2025.

The average annual energy consumption growth in Belgium is based on the long run growth prospects forecasted by the PRIMES model (source draft study of the prospects of electricity supply in Belgium 2008-2017 conducted by the ministry of energy and the Belgian Federal Planning Bureau – 3 December 2008). For the medium term (+1 year till +4 years), the growth rates of PRIMES are adapted in order to address the most recent trends of Belgian energy consumption, notably the current global recession. The average annual energy consumption growth rate used in this forecast for the period 2008-2010 is -1,4%.

In Belgium there are numerous load-shedding contracts with industrial customers regarding load-management. These contracts are part of the system services reserve.

Generation adequacy

If the generation development projects of scenario B (best estimate generation scenario) are realized within the indicated deadlines and no additional decommissioning based on technical life times takes place, the remaining capacity will ensure self-sufficiency from 2010 till 2015. From winter 2016 on, the system will rely on supplementary generation development projects that are as yet unknown to maintain the remaining capacity at a sufficient level. A level is estimated as sufficient when it ensures that Belgium doesn't rely on structural import from neighbouring countries. However, in case of the minimum investment scenario (scenario A), the interconnection transmission capacity will remain crucial after 2010. Furthermore the simultaneous import capacity in 2025 based on confirmed interconnection projects is insufficient to compensate the lack of national generation. The remaining capacity in 2010 in scenario A and B will ensure self-sufficiency under normal circumstances due to lower predicted loads for 2010 than foreseen last year due to the economic and financial crisis.

An adaptation of scenario A, assuming a postponement of the nuclear phase out with 10 year, reveals that the interconnection transmission capacity will remain crucial throughout the period 2015-2025. If the additional decommissioning based on the technical life times is not included in the assessment, the remaining capacity will ensure self-sufficiency from 2010 till 2020. From 2025 on the start of the postponed nuclear phase out will results in a need of supplementary generation development projects that are as yet unknown to maintain the remaining capacity at a sufficient level.

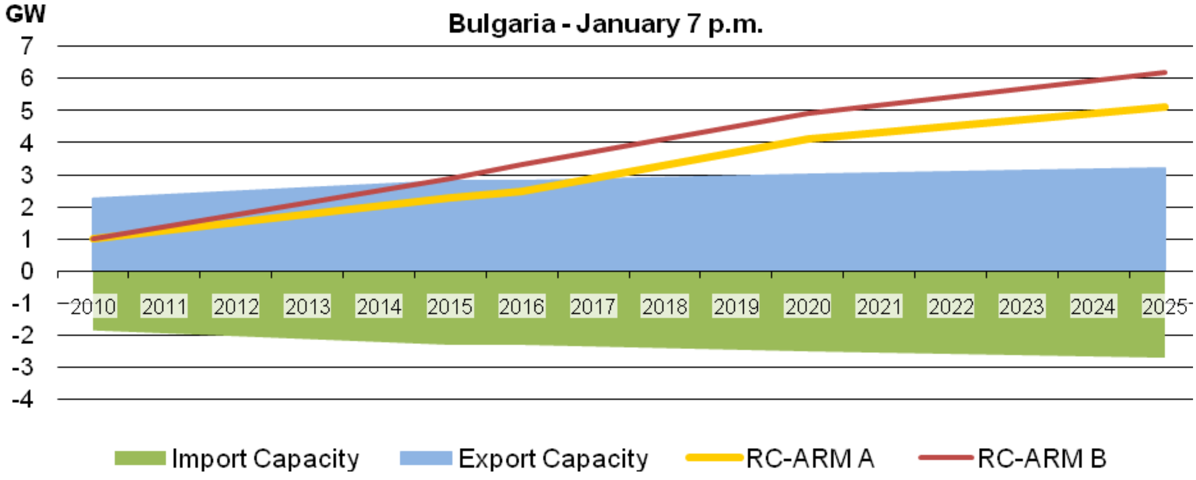
ENTSO-E AISBL • Avenue Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

Unavailable capacity will increase over the period 2010-2025 mainly due to a rise in the number of wind farms, biomass power stations and CHPs included in the net generating capacity. This trend will lead to an increase in the volume of non-usable capacity. The wind power capacity considered as non-usable is 90 percent. 50% of the net generation capacity of nuclear units is considered as unavailable one year before their decommissioning. This leads to higher non-usable capacities in 2015 and 2025. The higher net generating capacity of windmills in the future will result in a rise in the volume of the system services reserve. The magnitude of the increase in minutes reserve due to the higher penetration level of windmills is currently under investigation. Therefore the system services reserve reported in this forecast 2010-2025 are based on the volumes required for 2010. They consists of 97 MW primary reserve, 706 MW minutes reserve and 363 MW other reserves. Only 497 MW (137 MW secondary reserves and 360 MW tertiary reserves) of the minutes reserve is considered. The remaining 209 MW of the minutes reserve are load shedding contracts with industrial customers. This type of reserve in not included in the UCTE definition of system services reserve. The 363 MW 'Other reserves' is contractually imposed by Elia on the generator with the biggest unit, but does not fall under the operational responsibility of Elia. The origin of the imposition, although it comes through the ARP contract is the Grid Code: every ARP is responsible for his own balance. This reserve is included because it is a part of the system services reserve as determined by the UCTE rules.

Interconnection Capacity

The simultaneous import and export capacity was obtained by adding the NTC values of both borders and multiplying this sum with a simultaneous coefficient of 70 percent. The simultaneous import capacity of Belgium is affected by the commissioning of a phase shifter in Zandvliet and two phase shifters in Van Eyck and will be influenced by the commissioning of the second circuit of the 220 kV AC Aubange-Moulaine line (begin Q2 2010). Future possible interconnections, which are still under study (such as new interconnections between Belgium and Luxemburg, between Belgium and Germany and between Belgium and the UK and additional interconnection capacity between Belgium and France) are not considered in the current assessment of the simultaneous import and export capacity.

5.4 BG – Bulgaria



The representativeness index is 99 % because part of the small hydro and wind generators are connected to the distribution grid.

Generating capacity

The expected development of the generating capacity will guarantee reliable operation of the system satisfying domestic consumption and increasing export capabilities

Expected new additions of generating capacity in the period are as follows:

- Nuclear - 2000 MW
- Lignite - 660 MW
- Gas - 600 MW
- Wind - 2950 MW
- Photovoltaic - 75 MW

Load

The load forecast is made taking into account the most probable development of the country under the conditions of the global economic and financial crisis.

No Demand Side Management has been planned up to now.

Generation adequacy

All values will be kept stable throughout the whole planning period.

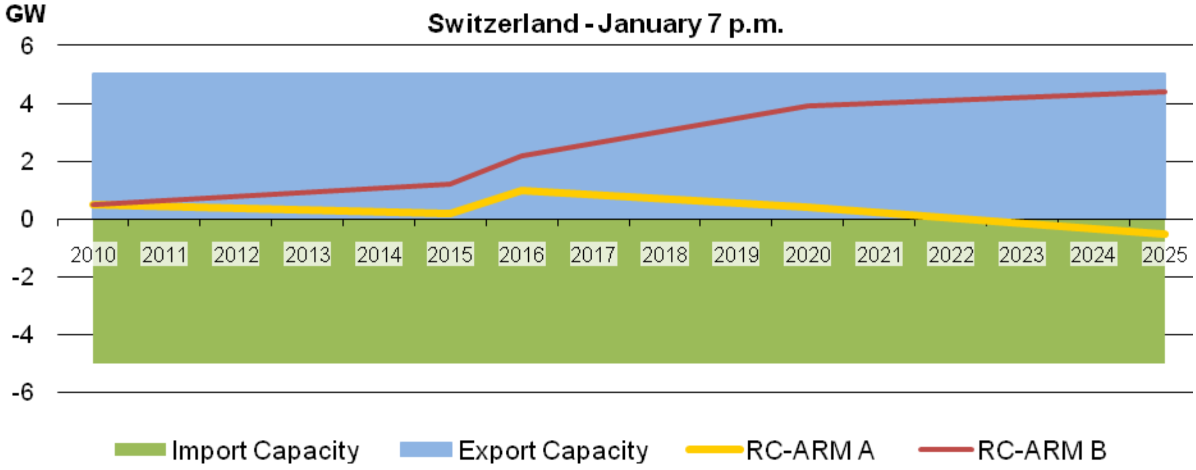
There will be a slight increase of the unavailable capacity due to the expected increase of the non-usable capacity and the outage rates of older units

The remaining capacity will increase significantly due to expected new additions of generating capacity and the relatively low growth rate of national consumption.

Interconnection Capacity

The simultaneous transmission capacity will increase after the expected connection of the Turkish power system to ENTSO-E.

5.5 CH – Switzerland



National representativeness is 100%.

Generating capacity

The authorization of 3 hydro power plant projects is practically accomplished resulting in 1.2 GW of additional capacity in 2010 and another 1.6 GW till 2016. This clearly improves the prospects of scenario A (remaining capacity is higher than adequacy reference margin till 2020 at least).

Load

The load growth between the years 2010 and 2025 is assumed with 1.5% per year.

No load management is used in Switzerland.

Generation adequacy

In scenario A additional capacity will be needed only by 2025. In scenario B all promising power plant projects are considered.

Unavailable capacity in winter - 75% of the run of river hydroelectric power plant's capacity, 10% of the capacity of the storage hydro power plants, 20% of the mixed pump storage hydro power plant's capacity, 20% of the pure pump storage hydro power plant's capacity, 5% of the nuclear power plant's capacity, 5% of the large fossil fuel thermal power plant's capacity, 5% of the small conventional thermal power plant's capacity, 100% of renewable energy sources, 100% of other plants.

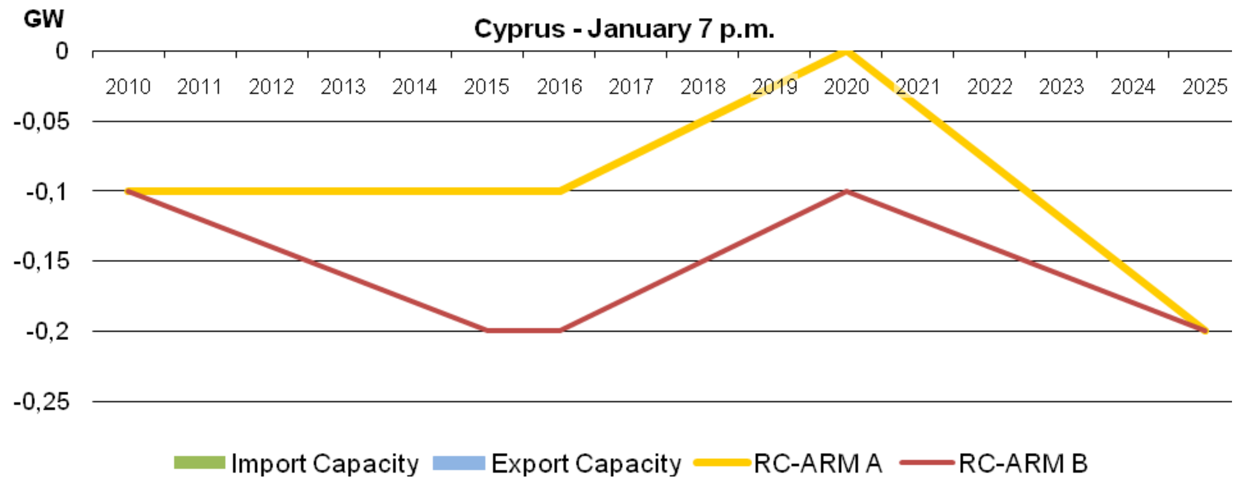
Unavailable capacity in summer - 35% of the run of river hydroelectric power plant's capacity, 100% of the small conventional thermal power plant's capacity, 100% of renewable energy sources 100% of other plants.

Interconnection Capacity

Our new estimation is that the import and export capacity are equal and as of 5.0 GW.

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

5.6 CY – Cyprus



Generating capacity

Due to recent political decision for the gradual entrance of natural gas and substitution of oil as a primary source for electricity production in Cyprus we adjust the future input as far electricity generation with fossil fuel is concerned.

Therefore the percentage of fossil fuel used for electricity generation will be as follows:

2010 - 100% Oil and 0% Gas

2015 - Approximately 30% Oil and 70% Gas

2020 - Approximately 10% Oil and 90% Gas

2025 - 0% Oil and 100% Gas

Load

The average annual energy consumption growth for Cyprus is estimated to lie between 3.5% - 4.7 % during the time period 2010-2025. Load forecast is mainly based on data of previous years. For certain load groups (i.e. storage heaters, air conditioning units and water pumps) load management is applied.

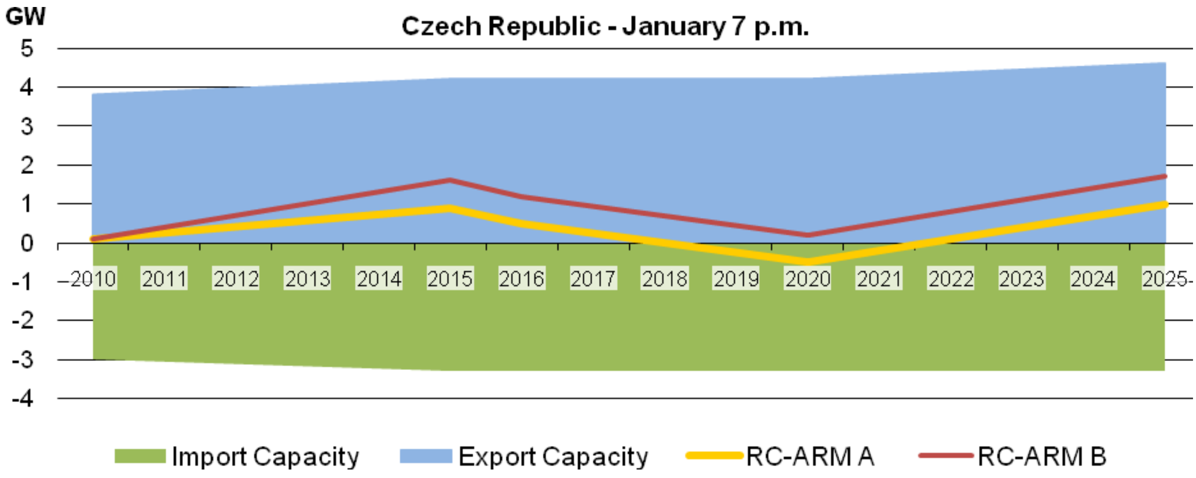
Generation adequacy

Based on the assumed development of load and generation capacity, the overall generation adequacy will be maintained at satisfactory level, which will ensure the safe and smooth operation of the Cyprus System at all times.

Interconnection Capacity

The Cyprus System is an isolated System and therefore has no interconnection capacity.

5.7 CZ – The Czech Republic



Generating capacity

No comments provided.

Load

Average Annual Energy Consumption Growth in the period 2010-2015 is lower than in the period 2015-2016 due to financial crisis effect, causing low consumption growth during 2010 and 2011. Saturation effect takes place after 2020.

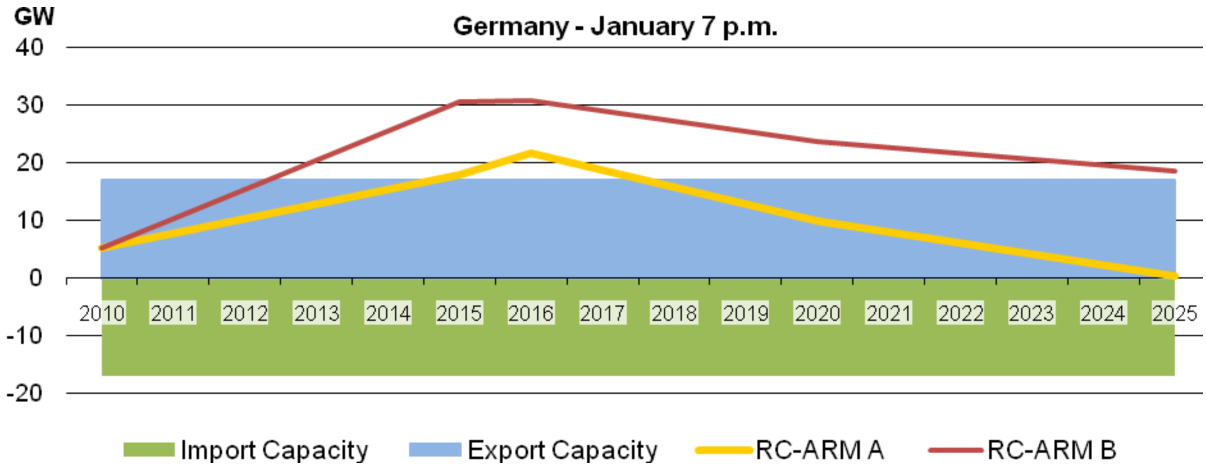
Generation adequacy

No comments provided.

Interconnection Capacity

No comments provided.

5.8 DE – Germany



Generating capacity

The increase in renewable-based generating capacity during the period from 2010 to 2020 is expected to be than 38 GW (Sc A). The major part will be wind power but also solar power.

The consensus achieved about the remaining life of nuclear power stations leads to a strong decrease in the capacity of nuclear power plants and is visible in this forecast.

The increase in thermal conventional capacity is mostly based on hard-coal and gas-fired power plants.

Some generating capacity of regional and municipal companies which is not known in detail has been assigned to the category “Not clearly identifiable”.

Uncertainties concerning future commissioning and decommissioning of power stations in Germany have to be noticed. The phase-out of nuclear power stations decided by the former government is again under discussion. The election to the ´Bundestag´ in autumn 2010 will lead to different political constellations compared to last year´s forecast. That could have an effect on the future operational utilisation of the existing nuclear power stations. Furthermore, there is a general political discussion going on about the realization of the planning of coal-fired power stations related to the CO_2 problem.

Load

The implementation of energy saving measures and the increase in technological efficiency, respectively, will lead only to a moderate growth in electricity demand in Germany.

There are not any (relevant) measures in load management implemented in Germany.

Generation adequacy

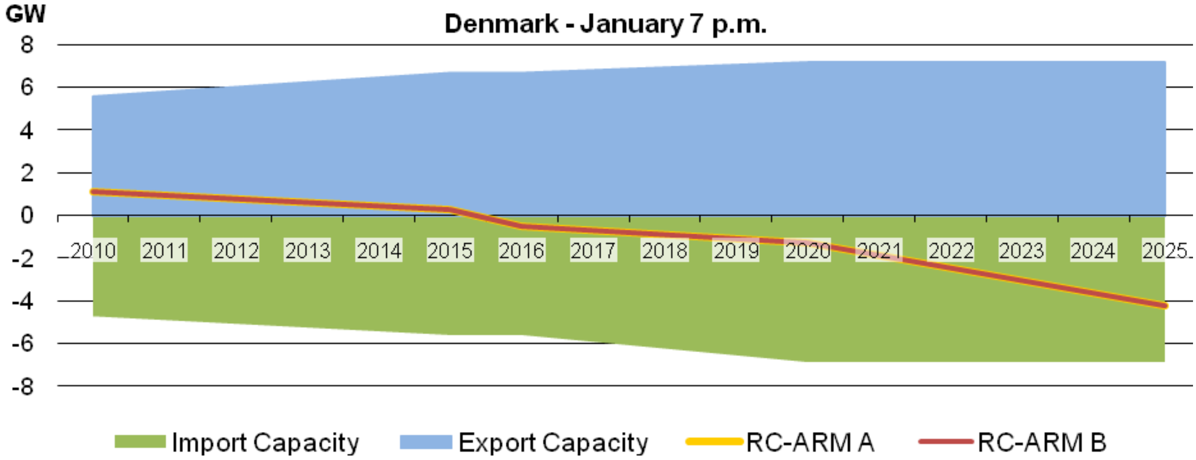
From the TSOs’ point of view, power station operators would have to secure at least the output of the largest unit as hours reserve within the respective control area, as the TSO makes the reserve available only for a maximum of one hour (dimensioning of system services). However, almost all power station operators try to reduce this power through pooling with other power station operators.

A large part of the generating capacity of wind and solar energy plants needs to be considered as “non-usable” or “unavailable” capacity owing to the stochastic nature of wind and sun energy availability. Generally, it has to be noted that power station operators consider data on “non-usable capacity” to be sensitive information in terms of competition; for this reason, detailed information of this kind is not made available to system operators. The data used for the power balance forecast are values estimated on the basis of pragmatic values obtained prior to the liberalisation of the German electricity market.

Interconnection Capacity

Simultaneous Interconnection Capacity depends on the grid topology. It varies between 10 and 17 GW. NTC values for the years 2010 to 2020 will be calculated by ENTSO-E experts and published by ENTSO-E; they are currently not available for the future time periods.

5.9 DK – Denmark



The SAF report is for the whole of Denmark and therefore not divided into West and East Denmark.

Data is not divided on scenarios A and B but reported as most likely values under scenario B.

Generating capacity

Only planned (not decided) decommissioning is registered. Energinet.dk has no knowledge about new commissioning of plants in the period 2010-2025.

Load

No comments provided.

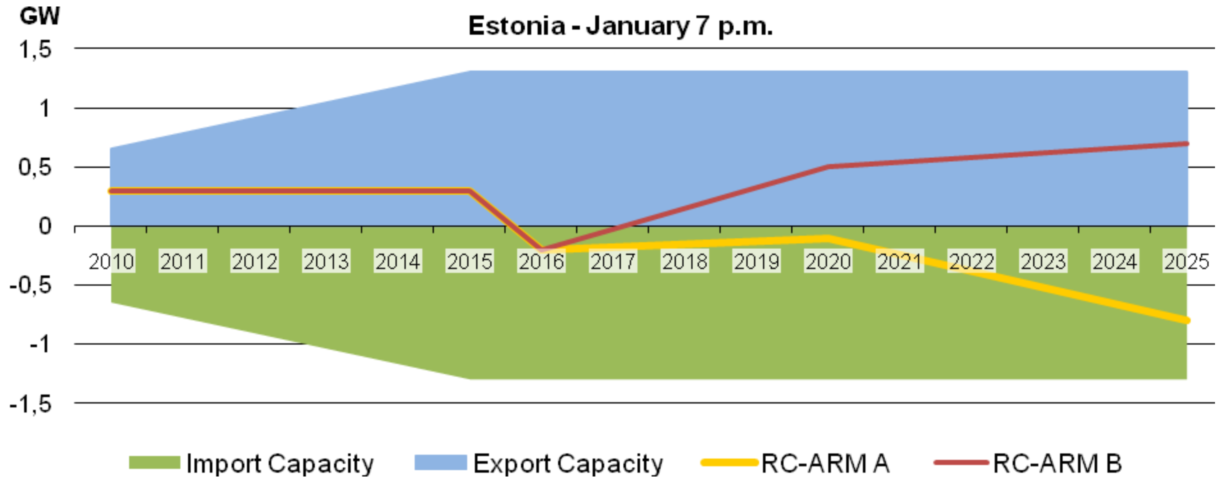
Generation adequacy

No comments provided.

Interconnection Capacity

No comments provided.

5.10 EE – Estonia



Generating capacity

Time period 2010-2016 - The power system of Estonia has at present 2.3 GW of generation capacity installed. The main producer AS Narva Elektrijaamad, oil shale PP, generates about 90% of total electricity and has 2 GW NGC. The power units, which have NGC about 1.6 GW, do not meet the requirements of the EU directive of large combustion plants, which means that without additional desulphurization installations they will be considered as non-usable capacity. To fulfil the environmental requirements, it is decided to install SO2 filters to four existing oil shale burning units, which total net capacity is 0.644 GW. This installation will be completed by 2016. The rest 6 power units of Narva PP will be mothballed after the year 2016.

Time period 2016-2020 - Energy demand will be covered by the old oil-shale power units which will be equipped with new flue gas cleaning filters, CHPs based on different fuels (gas, peat, firewood), wind parks. Additionally it was assumed during 2016-2018 new oil-shale units with NGC of 600 MW in Narva PP will be constructed (B-scenario). All new CHP were assumed as not clearly identifiable capacity.

Time period 2020-2025 - There will be operated fluidized-bed blocks, CHPs based on different fuels, wind parks and the new nuclear power plant (B-scenario) is assumed after the year 2022.

In Scenario A only those new developments that Estonia TSO currently knows to bounder construction have been included. Scenario B is consistent with our ‘Best View’ generation background.

Load

Consumption forecast consists of two different parts:

1. Share of inertia based on last three years consumption,
2. Share of GDP (gross domestic production) and according to economy forecast of government authority.

In pessimistic scenario slow consumption recovery from economy crisis and slow stable consumption increase after 2015 is foreseen. Optimistic scenario assumes fast recovery and higher annual increase and electricity consumption after economic recession. The increase smoothly stabilises after 2020 and stay at the same level up to 2025.

Generation adequacy

Generation adequacy of the Estonian system should not be at risk up to 2016. The first problems may arise in 2015, when the emissions limitations of existing oil shall units will be in force and after that, in 2016, after mothballing of six units of Narva PP.

Considering A scenario the situation will deteriorate from 2016 and inadequacy may reach up to 0.2 GW in winter period of time during 2016-2022 and will be increased up to 1 GW during the years 2022-2025. A scenario shows the necessity of construction of new generation units or import for the time period 2016-2025.

Under B scenario remaining capacity would be met with a surplus during the whole period. During reference days (3^{rd} Wednesday of January) only according to A scenario RC has negative value.

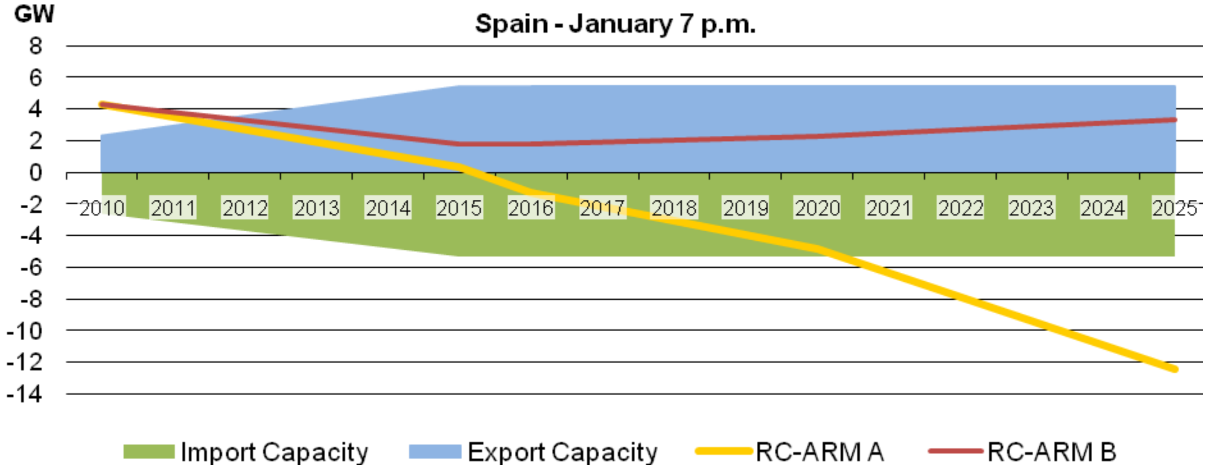
Non usable capacity was considered consisting of power of mothballed units, all kind of limitations and all installed wind power. The power units that have NGC about 1.02 GW will be mothballed due to emissions limitations starting from 2016. It was assumed that about 50% of CHP power would be unavailable due to the maintenance and technological limitations during summer period. According to hydrological conditions (water inflow), it was assumed that available capacity of hydro power plants would be about 50% of their net generating capacity. Outages of generating units are calculated as 2% of net generation capacity for all power plants till 2016 and about 1% after 2016.System reserve is emergency reserve (largest unit and considering agreement between TSOs). Starting from 2015 our emergency reserve will increase due to Estlink 2 (considered as largest unit).

Seasonal peak load in summer is a peak load in time period June-July-August. Seasonal peak of winter period is the same as yearly peak. Seasonal peak is expected to be about 15% higher than load at reference day. Values at 11 a.m. and 19 p.m. of 3^{rd} Wednesday are estimated as average of three last year's load at the same date and time. The loads of last three years are converted as per unit values against yearly peak load.

Interconnection Capacity

Estonia energy system has 6 interconnections: one with Finland, three with Russia and two with Latvia. Taking into account limitations of 330 kV network the possible export will be in range of 0.65-1.3 GW in winter and 0.6-1.25 GW in summer during 2010-1016. The increase of interconnection transmission capacity will be expected after construction of new interconnection (Estlink 2) with Finland and reinforcement of 330 kV network after 2016.

5.11 ES – Spain



Generating capacity

The peninsular Spanish electricity system is characterized by a high degree of penetration of renewable generation. The integration of large intermittent renewable generation and the minimization of the loss or spillage of renewable energy during periods of reduced demand are strategic objectives for the System Operator. These goals are framed in a more general level of development and promotion of electricity generation from renewable sources driven by the Government in the context of fulfilling the objectives set by the European Union by 2020.

Installed wind power is expected to more than double from 17 GW (January 2009) up to 36.5 GW in January 2020 (including offshore), and keep growing until 45 GW in 2025. At this point, wind power will represent 1/3 of overall installed capacity in the Spanish peninsular system.

Solar energy (both thermoelectric and photovoltaic) is expected to quickly develop in the medium term, reaching 9 GW in 2015, and to keep growing at a lower but steady pace up to 14 GW in 2025.

Generation expansion planning is also based on the commissioning of new combined cycle gas turbines (CCGT). At present there are 9 units under construction, representing a total amount of around 3.7 GW, expected to be in operation before the end of 2012.

There is also a 100 MW gas turbine (OCGT) under construction, scheduled for 2010. From then on, more OCGT projects are expected in both A and B scenarios.

In the medium term (2012-2015) it is not clear whether additional CCGT projects will be developed; scenario A covers the case in which no new CCGT were to be built after 2012. Best estimate scenario from the System Operator, which is based on keeping a coverage index equal to 1.1, considers the commissioning of nearly 3000 MW in 2013-2016. As for the longer term, there are some projects concerning coal fired units with carbon capture and storage (CCS), but they are uncertain at the moment and hence have not been taken into account.

As regards hydro generation, a few repowering for a total amount of 500 MW are expected until 2015. The construction of pure pumping units is considerable, with around 3000 additional MW in operation before 2016.

These are the most important assumptions taken into account for the calculation of non-usable capacity in terms of system adequacy forecast:

- Thermal forced outage rate: available thermal capacity with probability of 95% has been considered.
- Dry hydro conditions: significant non usable hydro capacity resulting from lack of water in the reservoirs.
- Wind conditions: available wind capacity with probability of 90% has been considered.

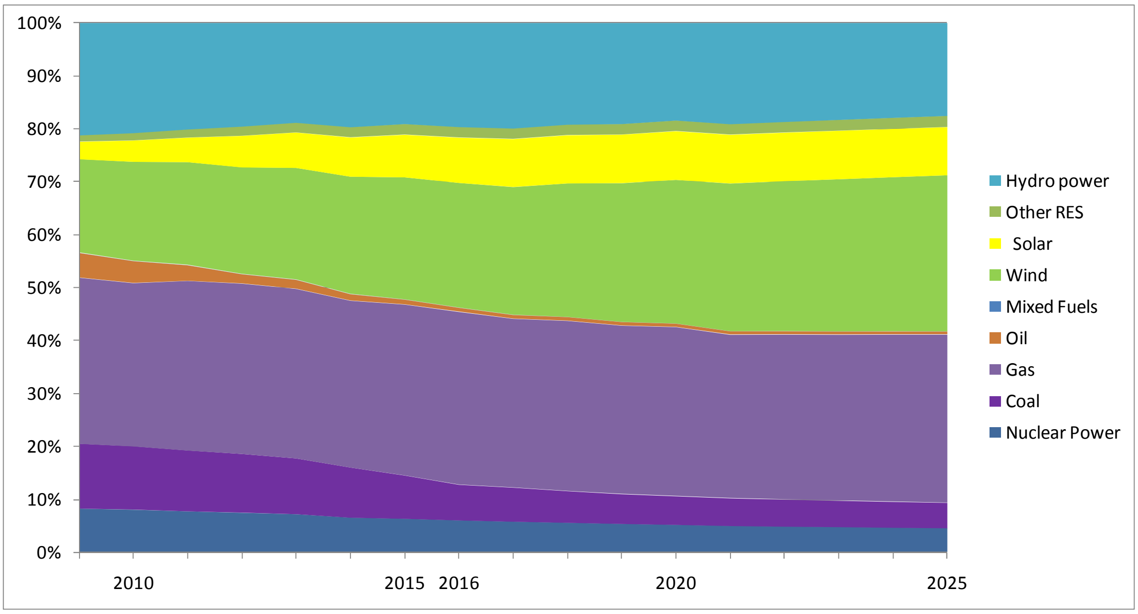


Figure: Forecasted share of installed power in Scenario B

Load

Over the last six years, demand growth rate has decreased, from historical values of 5% (period 1995-2005) up to 3% (in 2006, 2007) reaching a practical stagnation of demand over the last year (2008). Electric energy intensity (corrected electricity demand growth divided by GDP growth) has also diminished over the years, reaching now values below 1.0, compared with historical values of 1.3.

The demand coverage studies are based in the demand forecast studies carried out by Red Eléctrica. From these studies, values for annual energy and annual peak demand are forecasted, values that will define the evolving needs of the generating equipment to meet this demand and to maintain the security and quality of electricity supply. Energy is expected to keep growing at values of 2% (y/y) at the end of the period, and peak demand is expected to reach 60 GW in the winter of 2020 under severe conditions.

Generation adequacy

In the short term, the situation of the Spanish system is nor critical for the next year, and forecasted remaining capacity (RC) is higher than adequacy reference margin (ARM) even in case of extreme peak demand.

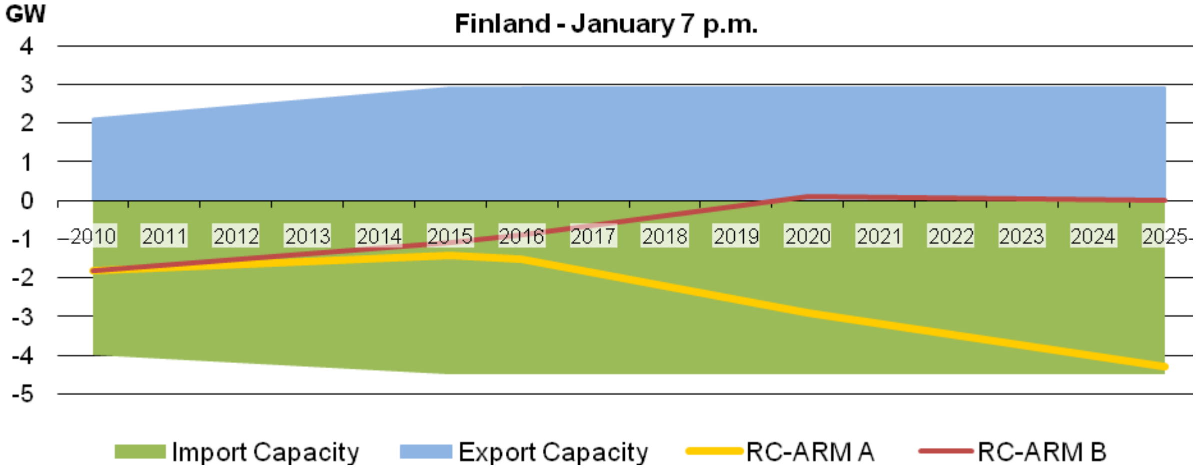
In scenario B, RC seems sufficient for all 2010-2025 period. However, if no new thermal capacity was commissioned (scenario A), this margin (RC-ARM) will be reduced and the system could be in shortage in the year 2016. This year is also affected by the LCP Directive, which imposes the decommissioning of certain coal and fuel plants by December 2015 at the latest.

Interconnection Capacity

Increase of interconnection transmission capacity between Spain and France (and hence the rest of ENTSO-E system) is one of the main concerns of Spanish TSO regarding adequacy evolution, as well as the increase of transmission interconnection capacity with Portugal in the framework of the development the Iberian electricity market. Simultaneous import capacity is expected be more than doubled from 3.2 GW in 2010 to 6.6 GW in 2015, thanks to the new Spain-France interconnection (expected in 2014) and also to new interconnections with Portugal in 2011 and 2012. Export capacity will also reach values close to 7 GW.

Furthermore, the benefits of the development of the Spain-France interconnection include the improvement of the quality and safety of supply, the growth of energy trade between Spain and the rest of ENTSO-E, as well as also allowing greater integration of renewable energy into the Spanish peninsular system.

5.12 FI – Finland



Generating capacity

The generation capacity in Scenario B reflects the outlines in the national Long-term Climate and Energy Strategy approved by the Finnish Government in November 2008. Government´s aim is ensuring sufficient, moderately priced electricity sourcing that supports climate objectives.

The nation’s own production capacity should be able to provide for peak consumption and possible import disturbances. As very little details are given in the Strategy, the generation capacity mix here is based on TSO´s estimate. Many power plants use several different fuels. Hence, power plants are classified according to their main fuel. Renewable (other than hydro and wind) in most cases means black liquor or wood in different forms while ´non-identifiable´ mostly means peat as the fuel.

Load

During the first years a fast recovery after the economic recession is assumed.

Some demand response is included in winter peak load i.e. it is considered in Margin Against Seasonal Peak Load.

Generation adequacy

In Scenario A the Remaining Capacity in winter remains negative the whole period under study the amount increasing towards the end of the period. In Scenario B the Remaining Capacity is negative until the commissioning of a new nuclear unit in 2012. After that the Remaining Capacity is positive as new capacity is expected to be constructed to meet the peak load in cold conditions as explained in comments for Net Generation Capacity above.

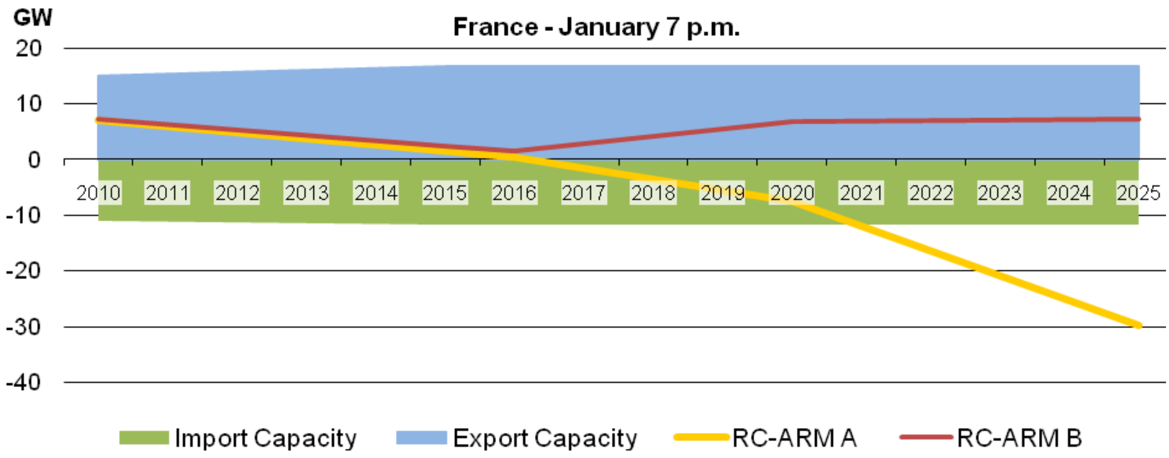
Temperature has a major impact on the demand in winter and is hence the most critical factor for the adequacy of the Finnish and other Nordic systems. Compared to normal temperature conditions (reference in this study) the demand can be 5 to 10% higher in cold conditions corresponding to a probability of once in ten years. Reference load corresponds to a probability of once in two years. Margin Against Seasonal Peak Load equals this difference assuming some Load Management in cold conditions included, however. In summer the impact of temperature is smaller.

6% of wind power capacity is assumed to be available during the January reference hours while the assumed percentage in July is 0%. These figures are based on available statistics.

Interconnection Capacity

No comments provided.

5.13 FR – France [21]



Generating capacity

The pace of growth of the wind power industry is likely to be maintained at about 1 GW per year. The photovoltaic sector could achieve the 5.4 GW national targets in 2020 if the current trend holds. Biomass follows the pace of public calls for tender. New hydro power facilities will balance the restriction due to more severe downstream regulation. By 2015, the commissioning of CCGTs under construction and of the EPR in Flamanville should offset the shut-down of old coal fired units and CHPs.

Load

Demography remains the primary source of growth in demand. Second is that, with regulated prices still in force, electricity prices appears relatively stable and attractive compared to the price of energy sources which are volatile. Third is the development of new roles for electricity, notably leisure-related. On the downward side, a tightening of standards (ban on incandescent bulbs, energy labelling for new projects) in the residential and tertiary sectors is combined with a significant change in the behaviours of individuals and economic agents. The validity of these drivers remains unchallenged by the economic crisis.

Generation adequacy

The development of demand response mechanisms can usefully complement peak generation and requires the coordination of all stakeholders and regulation.

Non compliance with the adequacy criterion from 2013 onwards (sc. A) must be weighed against the increased margins in the neighbouring systems expected over this time horizon. 2015 appears to be a critical horizon especially with the end of the dispensation clause of the LCP Directive. Rising peaks call for an immediate investigation on the conditions for the development of peak units or demand response mechanisms. Beyond 2015, prospects remain wide open.

The development of electric heating and energy efficient lighting will push the morning peak up to balance the evening peak. The installation of heat pumps will increase the sensitivity to extreme cold temperature, especially in poorly insulated houses.

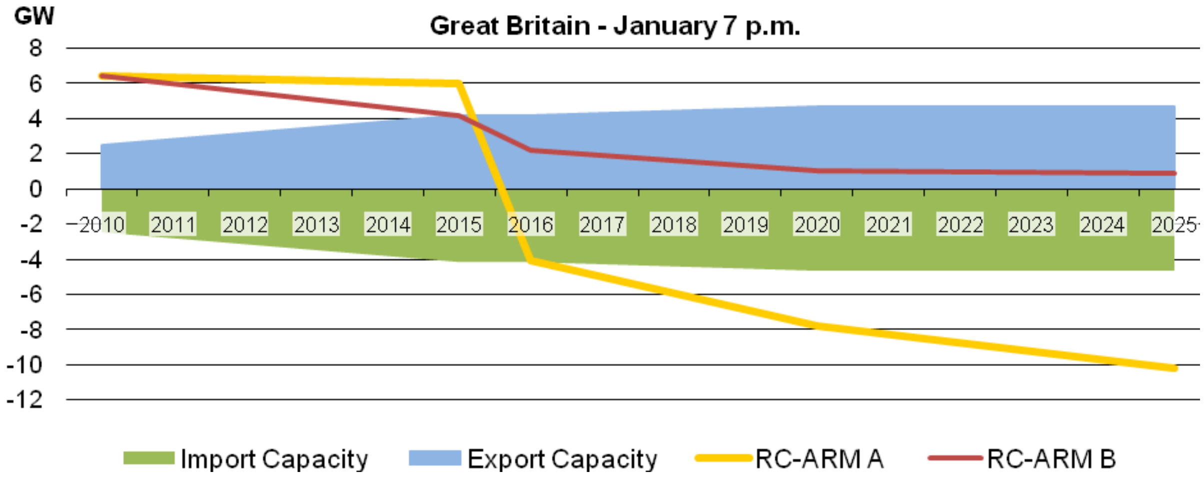
Interconnection Capacity

No comments provided.

---

[21] *See also:* www.rtefrance.com/htm/an/mediatheque/telecharge/generation_adequacy_report_2009.pdf

5.14 GB – Great Britain



Scenario A, the conservative view, includes the following assumptions:

- Large Combustion Plant Directive (LCPD) opt-out plant closes on 31st Dec 2015;
- Nuclear plant closes in line with the official closures dates as published by the Nuclear Industry Association;
- No plant closures due to the Industrial Emissions directive (IED) are assumed;
- The only new generation included are projects currently reported as under construction [as defined by National Grid's Seven Year Statement (SYS) August update]

Scenario B is consistent with the National Grid Business As Usual (BAU) best view forecast as published in the Development of Investment Scenarios document. More detail on this forecast can be found in this publication.

National Grid has also developed a Gone Green scenario which looks at the generation mix that would be required in order to meet the EU2020 energy targets.

Generating capacity

The commentary below relates to Scenario B. Scenario A differs as outlined in the general comments above.12 GW of coal and oil plant is forecast to close by 2015 due to LCPD. Nuclear capacity is expected to reduce by around 4.9 GW by the end of the forecast period. This is despite the forecast assuming that all the AGR nuclear stations are granted five year extensions beyond their existing planned closure dates, except where a longer extension has already been granted. Our forecasts do not include any new nuclear plant in the ten-year period. Our forecast is that the first new nuclear plant connects in 2019/20.Over the course of the next ten years, 13.6 GW of new CCGT plant capacity is predicted to make up the bulk of the shortfall caused by coal, nuclear and oil plant closures, with 7.5 GW of this capacity already under construction. Some of the existing gas stations are forecast to close over the forecast period, with this becoming more prevalent in the ten to fifteen year horizon due to the age of the stations and the impact of IED. The government recently announced that between two and four coal plants will receive government funding to assist in the development of carbon capture and storage (CCS). At the point when CCS becomes a ‘proven’ technology then all coal plants – and possibly gas – will have to have CCS technology. Our understanding is that this would apply to existing and new plants. Our forecast assumes 3.2 GW of new ‘clean coal’ capacity during the next ten years, with the possibility of existing plant also receiving funding to retrofit CCS. The first transmission connected offshore wind farm is forecast to connect in early 2010. A number of recent announcements have been made about the ´re-evaluation´ of large renewable projects, with lower oil prices, lower electricity demand and the difficulty in obtaining credit all resulting in project delays. This has resulted in a lower level of renewable generation forecast to connect to the transmission system in the earlier part of the ten-year period, although our ‘business as usual’ view in 2020 is similar to last year. 14.5 GW of new renewable plant is forecast to be built by 2018/19 with most of this connected to the transmission system. The vast majority of this renewable capacity is forecast to be onshore and offshore wind generation, with some biomass plant also forecast to connect in the ten-year forecast period. This will result in around 16% of electricity supplied coming from renewable sources by 2018/19. This is a higher number than previously forecast, principally due to lower electricity demand forecasts resulting in the renewable generation output being a larger share of consumption.

Load

The economy is an important attribute to National Grid’s electricity demand forecasts. In 2008, GDP growth was 0.7%, which is the slowest growth since 1992. GDP is expected to contract by 3.7% in 2009, which would be the lowest annual growth seen since 1946. Consumers’ confidence has been affected by the ‘credit crunch’. Economic recovery is expected to be slow, with only 0.2% growth forecast in 2010, and historical trend rates of between 2% and 2.5% p.a. not forecast until 2012. However, consumer spending is expected to fall in 2009 and 2010 because of the impact of ongoing factors such as low consumer confidence, depressed incomes, rising unemployment and low savings. With the effect of the recession and increasing energy efficiency measures, total GB annual electricity requirements is projected to continue to fall until 2014/15. Increasing end user demand is offset by expected growth in embedded generation, thus no growth in transmission electricity demand is expected over the period 2009/10 to 2015/16.

Generation adequacy

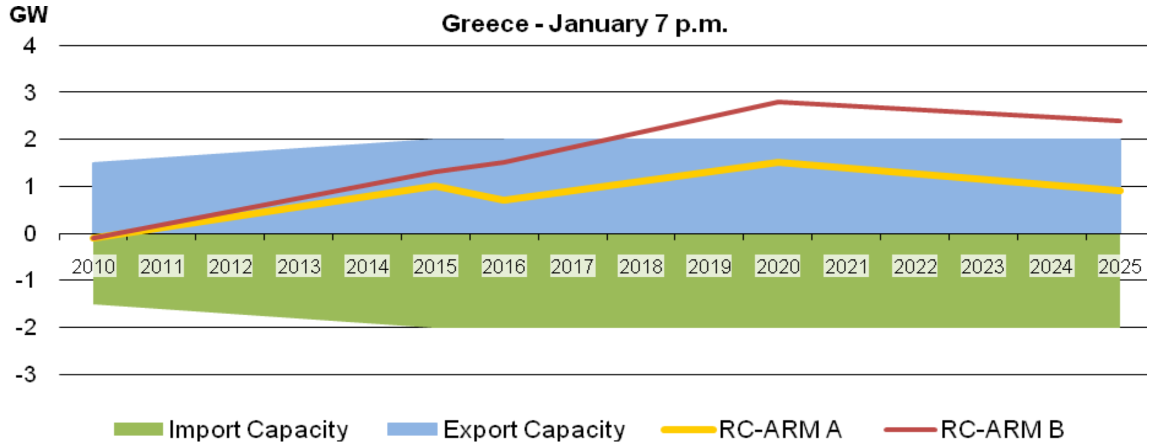
Scenario A assumes no new generation connecting apart from that currently under construction. The closure of 12 GW of plant due to the LCPD requires further generation capacity to be built by 2015, with additional generation needed beyond this due to ageing plant and further environmental restrictions. Scenario B assumes that adequate generation connects to the system as outlined above.

Interconnection Capacity

Interconnection capacity is forecast to increase with further connections to both Republic of Ireland and mainland Europe assumed.

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

5.15 GR – Greece



The data representativeness referring to the Greek Interconnected System is 100%. The remote systems of the Greek Islands are not included.

Generating capacity

Currently, there are two mechanisms considering new generation in the Greek system: the market-driven mechanism and through tenders by HTSO to ensure adequacy. The values presented here for years after 2016 are indicative. Considering renewable energy sources, new legislation has given strong motivation for the installation of photovoltaic systems (a target of 600 MW for year 2010 has been set). However, a delay for the implementation processes is expected.

Load

No comments provided.

Generation adequacy

The Non-Usable Capacity includes mainly hydro capacity (which is reduced due to limited water reserves) and capacity of wind power plants (an average of 75% of which is non usable during the summer peaks). The water management aims at saving the water reserves to use them at the peak demand and only along with irrigation management. The overhauls of the thermal power plants are avoided during periods of high demand. In this assessment a provisional overhaul schedule of the thermal units has been considered. The overhauls of the hydro power plants are implemented during periods of low use, that is low water reserves or low load periods. Therefore, the scheduled outages of the hydro power plants do not affect the remaining generating capacity. The forced outage rate of the thermal generating units is expressed by the Equivalent Demand Forced Outage Rate (EFOR). System services include primary, secondary and tertiary reserve according to the UCTE OH Policy 1.

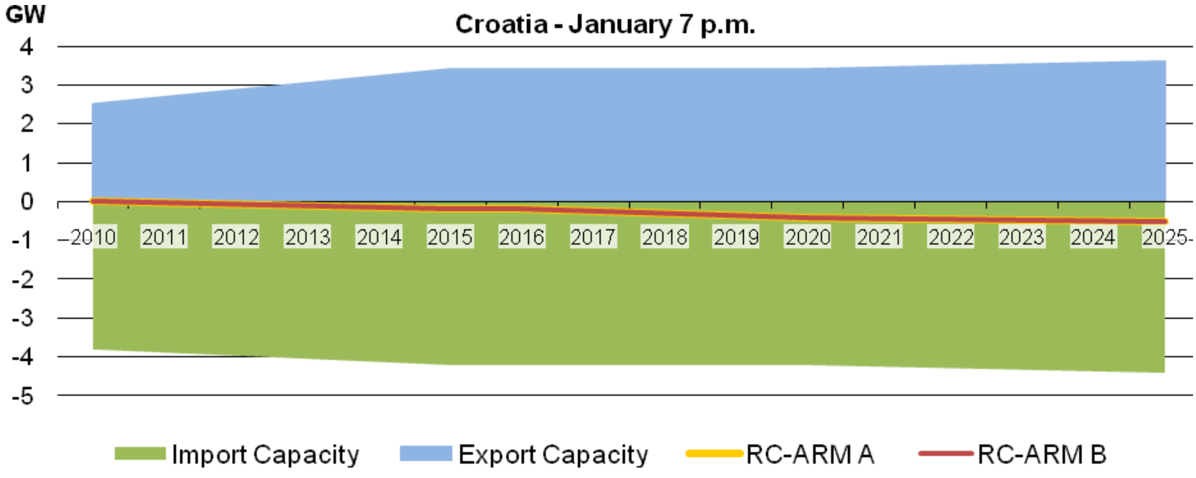
Types of load management measures:

- Industrial customers participate in a peak shaving scheme (new legislation since 2006)
- Irrigation management (during high peak hours, if necessary, irrigation is limited, through existing contracts)
- Incentives are given for the replacement of cooling appliances (air-conditioners and refrigerators) with new energy-efficient (class A) ones.

Interconnection Capacity

No comments provided.

5.16 HR – Croatia



The representativeness index is 99 % since TSO data does not include production of industrial power plants which was not delivered to the grid, but consumed in their industrial facilities.

Generating capacity

The commissioning of the new gas fired unit in TPP Sisak of 230 MW nominal power is expected in 2011. Commissioning of gas fired TPPs Slavonija and Dalmacija, of 400 MW installed power each, is expected until the end of 2013. The construction finalization of the coal fired TPP Plomin 3 of 500 MW installed power is planned within 2016, and also the end of operation of TPP Plomin 1 of 100 MW installed power. The construction possibility of combined cycle power plant “LNG” of 400 MW installed power exists in the next ten-year period in coastal region (depending on the location of the LNG terminal).

Till the year 2025, decommissioning of up to 1100 MW of old thermal power plants units that use fuel oil and coal is planned. The installed capacity of new renewable energy sources, mainly wind power plants, will amount between 400 and 500 MW by the end of 2012. The trend of construction of renewable energy sources will continue, in order that such installed capacity enables reaching national target of 19% total electricity demand in the year 2020. In the period from 2020 to 2025 the trend of construction of renewable energy sources will remain stable. As regards hydro power plants, new HPP Lešće with 42 MW installed power is under construction and its commissioning is planned in the year 2010. In the observed period till the year 2025 due to construction of new HPPs and revitalization and increase of the installed capacity of some existing HPPs total installed capacity will increase for 250 MW.

Load

In the observed period until 2025 the annual increase of electricity consumption is expected to mildly decrease due to energy efficiency measures. Load forecast has been built taking into account medium and long term projections of economic growth rate. Growth of the load depends directly on the industry development and growth of the household consumption.

Load Management measures will be considered in the Implementation program of the new national Energy strategy which is adopted in October 2009.

Generation adequacy

Remaining capacity will show a constant increase by 2015 dominantly due to increased volume of construction of gas fired thermal power plants. After the end of that cycle a slow constant decrease is expected, which will cause a need for smaller import of electricity in the period until 2025, but the dependence on imported energy will be reduced in relation to the current situation.

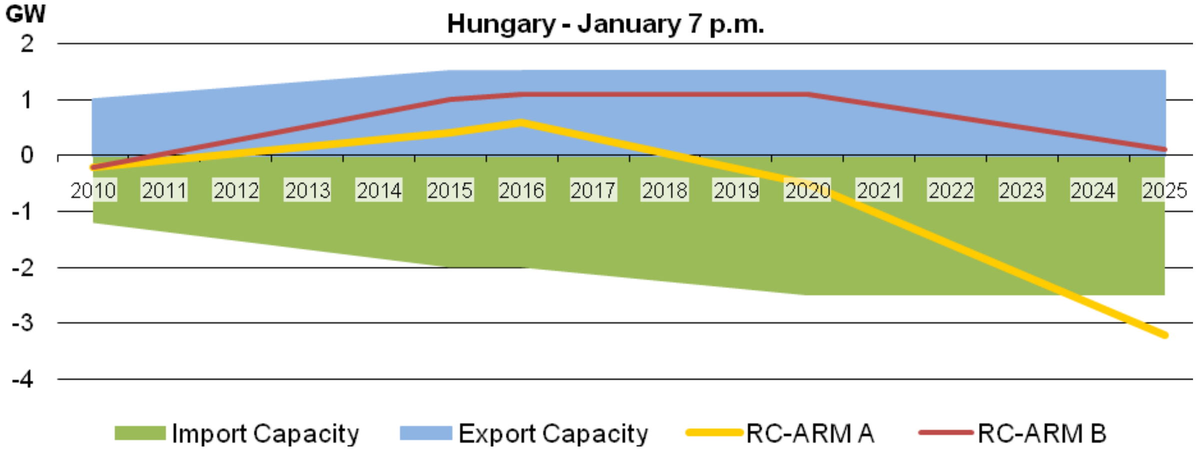
Depending on hydrological circumstances and availability of renewable energy sources (of which the installed capacity in the amount of net generating capacity will increase constantly) the constant increase of unavailable capacity is expected. A contribution to that will also come from the performance of the regular maintenance works of the generation facilities as well as continuous increase of necessary amount of System Service Reserve. This trend will be more significant than non usable capacity in old TPP units that will gradually stop operation.

The values of margin against seasonal peak load will remain stable during the observed period of the time.

Interconnection Capacity

Double power line 400 kV Ernestinovo – Pecs is under construction and will be commissioned in 2010. This double tie line between Croatia and Hungary is expected to increase operational security in region. The importing capability of Croatia and surrounding countries from central Europe and Ukraine is expected to be increased as well. A new OHL 2x110 kV Plat (HR) – Herceg Novi (ME) is under consideration. It could be the first transmission connection between Croatia and Montenegro. Under consideration is new 400 kV interconnection between Bosnia-Herzegovina and Croatia (depending on power plants projects realization in both countries). Project significance is bilateral and regional; it could enhance security of supply in both systems and strengthen the exchange and transit capacities in the region. A construction of 400 kV HVDC submarine cable with a 500 - 1.000 MW capacity between Dalmatia in Croatia and Italy is under consideration on long term horizon. According to the Agreement on ToR common feasibility study of both involved TSOs is in the finalization phase.

5.17 HU – Hungary



Generating capacity

No comments provided.

Load

No comments provided.

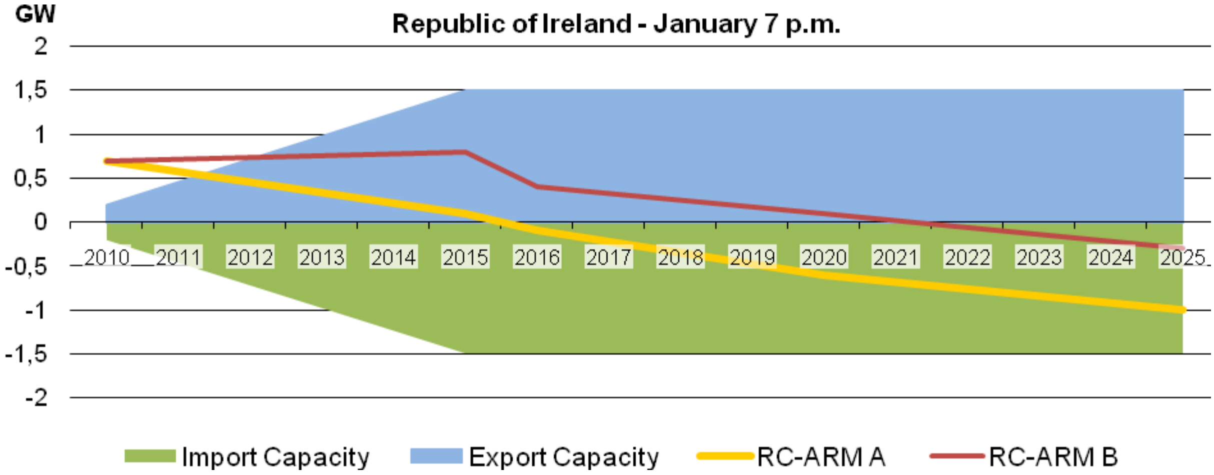
Generation adequacy

No comments provided.

Interconnection Capacity

No comments provided.

5.18 IE – Republic of Ireland



Generating capacity

Scenario A assumes that only generators with signed connection agreements will commission. Similarly, only decommissioning of which the TSO have been notified were assumed.

The Republic of Ireland will see a large increase in the amount of wind generation on the system as it works towards meeting its target of 40% of electricity from renewable sources by 2020. For the best-guess scenario (Scenario B), it is assumed that this target is met. Scenario B also assumes a commissioning of 690 MW of gas plant in 2013. Some wave-powered generation was included from 2020 onwards.

Peat is included with Fossil fuels.

Load

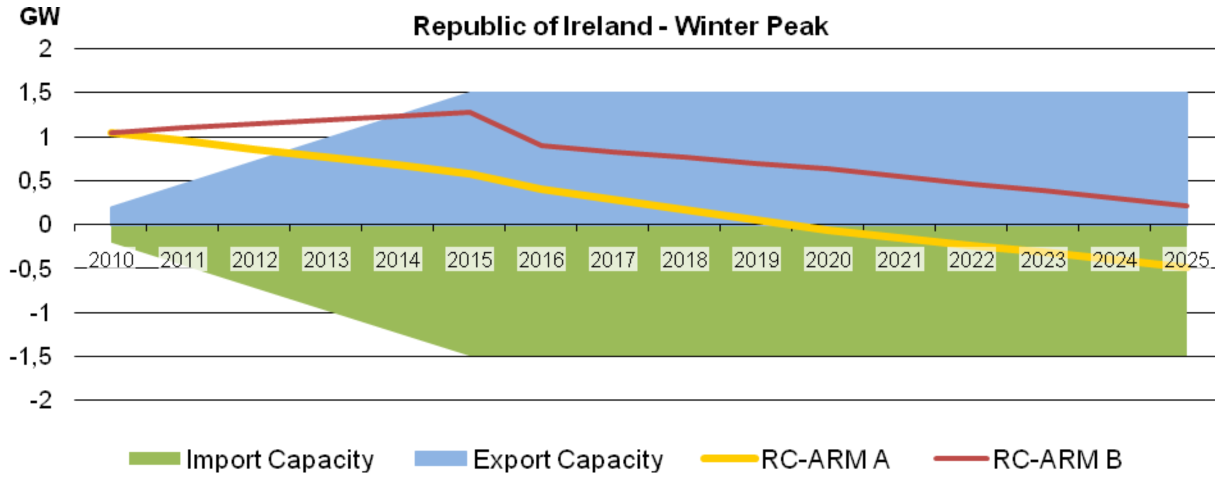
Load predictions are based on calculations carried out for the generation adequacy report covering 2010-2016. These calculations utilise GDP growth, personal consumption of goods and services, and population estimates to determine future demand. It is assumed that future economic growth will be less energy intensive than in previous years.

It is quite likely that a move to a low-carbon economy will bring behavioural and technological developments that will impact on demand patterns. However these have not been accounted for in our demand forecasts.

The winter peak in Republic of Ireland typically occurs in December at 6 p.m. UTC (5 p.m. CET).

Generation Adequacy

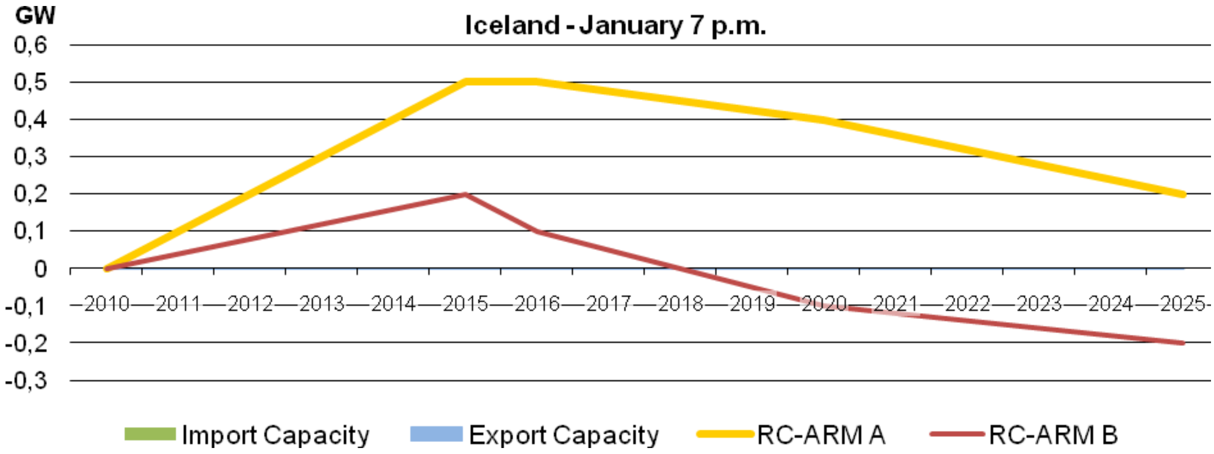
In the short and medium term, Ireland has a strong adequacy position. This is due to the addition of new gas-powered generation to the system in combination with a fall off in demand. However new generation will be needed for this adequacy level to be maintained in the long term.



Interconnection Capacity

Post 2012, the Republic of Ireland will have strong interconnection with Northern Ireland (~1000 MW). There will also be build 500 MW interconnection with Great Britain.

5.19 IS – Iceland



The Icelandic power system is small, so the addition of one, large customer will have a significant effect on the system adequacy, if not followed by new power plant(s). It is extremely difficult to forecast the development the next 10 - 15 years. Scenario B should though cover it.

Generating capacity

0.14 GW of capacity is devoted to system services (spinning reserve, etc.). Non-usable capacity is mainly due to the fact that approximately 5% of the installed capacity of geothermal power plants is reserved for ´in-house´ use (pumps, etc.).

Load

Estimated annual load increase is 0,9%. This is public (domestic) load. Diverse plans for power intensive industry are accounted for in Scenario B, with an average annual load growth of 3%.

A certain amount of curtailing load is used for load management.

Generation adequacy

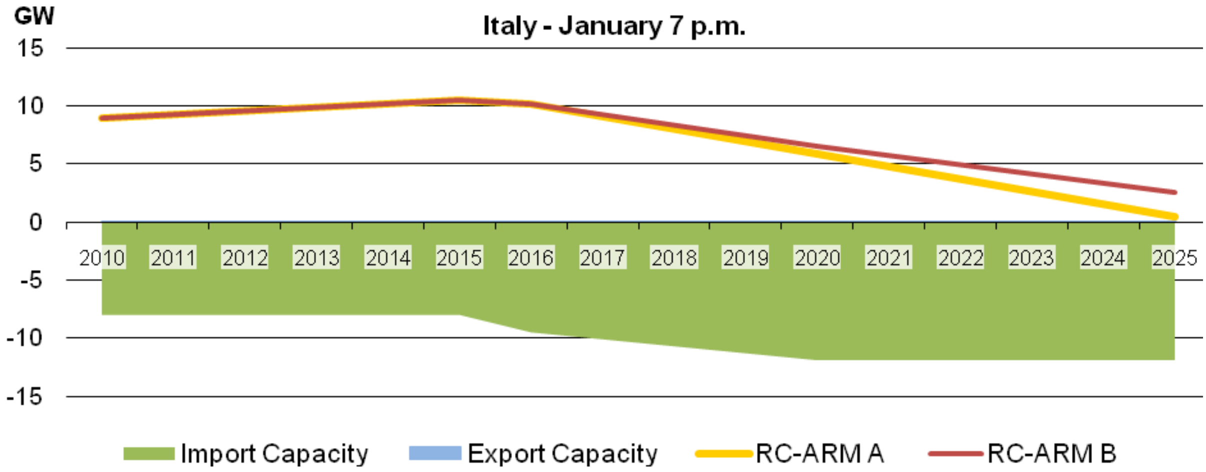
To cope with the load growth in scenario A, the planned new plants in the period 2010 - 2015 will be enough. For the growth in Scenario B, more production units have to be installed prior to years 2020 and 2025.

The seasonal variation curve is fairly flat for Iceland. This is due to the fact that approximately 70% of the consumption is power intensive industry, with a fairly high utilisation factor.

Interconnection Capacity

The Icelandic grid is an island, thus there are no interconnections to other grids.

5.20 IT – Italy



Generating capacity

An increase higher than 10.000 MW in conventional thermal power plants is expected between 2010 and 2025. By 2015, wind power plants are supposed to increase about 4.000 MW.

Load

For a better estimation of the power in order to cover future demand, we consider an intermediate evolution scenario.

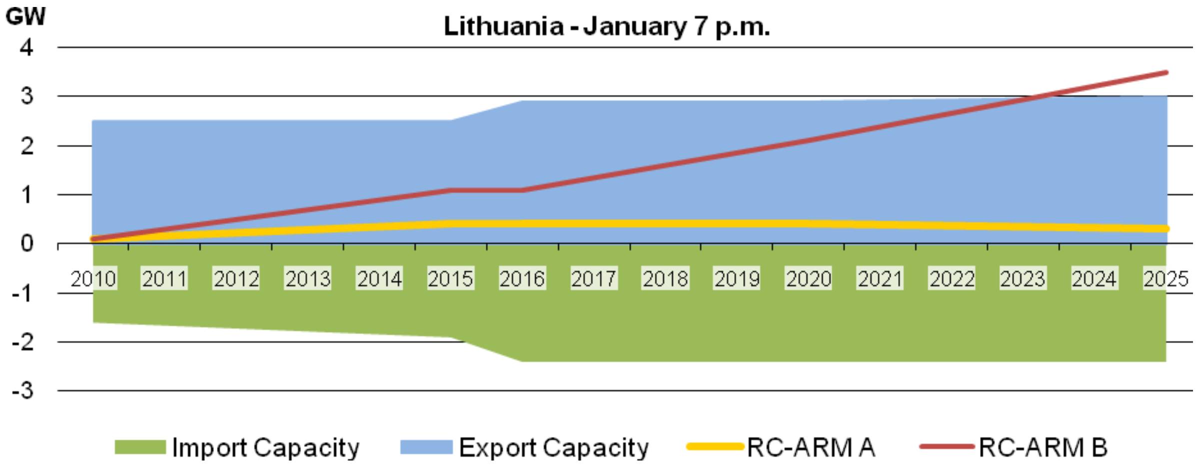
Generation adequacy

In normal conditions the remaining capacity, including only the signed imported contracts in most times will be sufficient. This value can be higher with a full import capacity. The spare capacity is assumed to be 5%.

Interconnection Capacity

The figures have been built considering all planned facilities included in “Piano di Sviluppo” of Terna.

5.21 LT – Lithuania



Data representativeness is 98% due to a limited access to data about generators, connected to distribution network.

Generating capacity

After closure of Ignalina Nuclear PP by the end of 2009, generation in Lithuania will be based on gas fuel. In conservative Scenario A just confirmed generation development projects were considered. The expected development of generating capacity will ensure reliable operation of the system covering domestic consumption.

Load

Forecast is based on GDP growth. Lietuvos energija AB is going to update load forecast taking into account influence of financial and economic crisis. Load increase in 2010-2011 is expected because of decommissioning of Ignalina Nuclear PP. The biggest generator in Lithuania becomes user.

No load management is used in Lithuania.

Generation adequacy

100 % of wind, 70 % of small hydro, 75 % of hydro pumps storage power plants (till construction of Nuclear power plant) were considered as unavailable capacity.

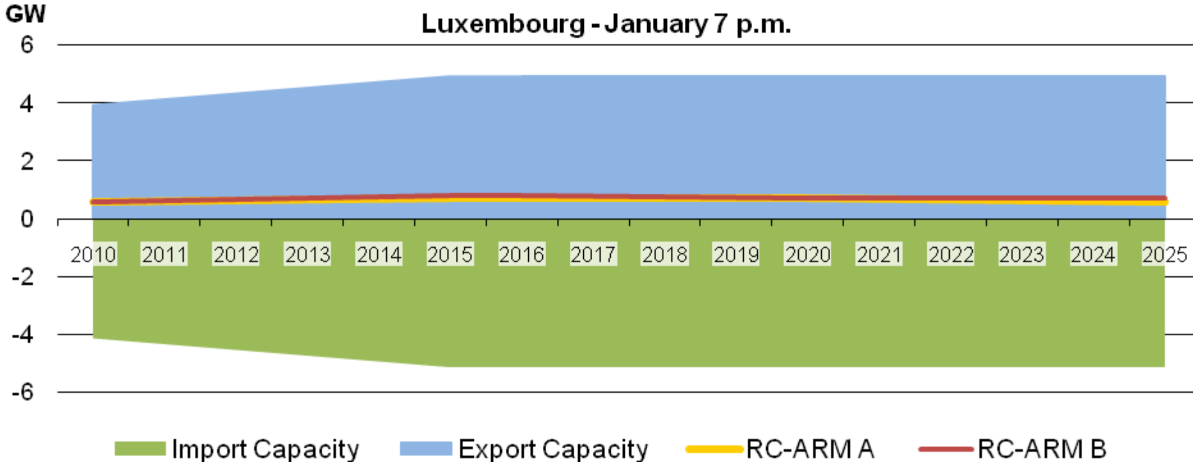
In both Conservative scenario A and Best estimate scenario B the Remaining Capacity is expected to be positive if new capacity will be constructed.

Outages can be planned on the basis of statistical data. However, after closure of Ignalina Nuclear Power plant by the end of 2009 (Ignalina NPP produces about 70 % of total electricity production), generation pattern changes radically in Lithuania. Therefore it is not appropriate to use statistical data base, which for sure will not correspond to the reality. Therefore Lithuania did not provide any forecast of outages, but presented data for maintenance and overhauls prognosis.

Interconnection Capacity

Preparatory works for implementation of construction of 400 kV double-circuit transmission line Lithuania-Poland project already started – completed feasibility study, implemented Project Development Company, environmental impact assessment is in progress. Commissioning of Interconnection expected in 2015. New 700-1000 MW capacity submarine cable between Lithuania and Sweden is expected in 2016. Feasibility study completed, seabed survey is in finalization phase.

5.22 LU – Luxembourg



Generating capacity

The figures for Luxembourg refer to the Luxembourg territory and include all the loads and power plants located on this territory, irrespective of the fact that some loads are connected in radial to the neighbouring grids or that part of the power plants inject energy direct to these neighbouring grids.

Load

We establish a direct correlation between load growing and national gross domestic product of the country. As important measures are encouraged by the politicians to maintain for the future the gross domestic product growth at a similar level as for the past, we can assume a further constant growing also for the load. Nevertheless, the economic stagnation resulted in a load capping in 2008/2009.

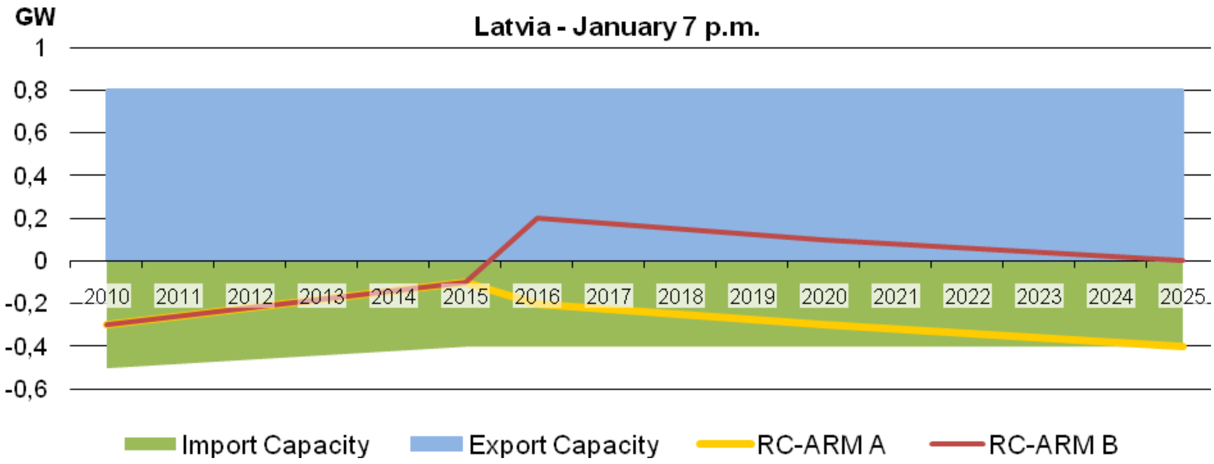
Generation adequacy

When considering the remaining capacity for Luxembourg it is very important to have in mind the grid configuration in this country. The two large power plants located on territory of Luxembourg do not inject their energy in the national public grid. As they are located at the borders they are connected via dedicated lines to the German grid of RWE and to the Belgium grid of ELIA. The public grid of Luxembourg depends highly on re-imports of this energy. The given remaining capacity is valid as contribution of Luxembourg to the interconnected ENTSO-E grid only and cannot be considered as isolated value for the grid of Luxembourg.

Interconnection Capacity

The import and export capacity takes into account the lines for the connection of the power plants located at the border on Luxembourg territory. The remaining interconnection capacity available for the grid is lower but is sufficient to cover the national load in the grid in normal operation. Transit flows between different countries through Luxembourg are not possible. As Luxembourg is depending highly on imports of energy, the n-2 case is considered for the security of supply and a reinforcement of the interconnection capacity by 2015 is needed and already scheduled.

5.23 LV – Latvia



Generating capacity

No comments provided.

Load

Weighted GDP growth forecast taking into account load inertia factors.

Generation adequacy

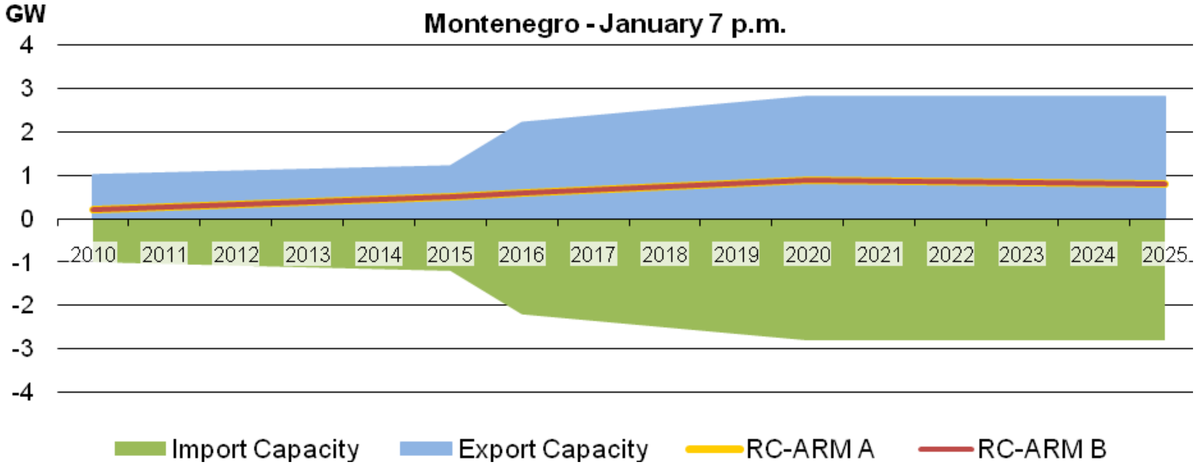
In scenario B, in the year 2016 new fossil-fuel TPP is being commissioned.

The amount of unavailable capacity is given by the limited water inflow (weekly regulation of dam level).

Interconnection Capacity

These values correspond with maximum possible import and export of the system at the normal network topology.

5.24 ME – Montenegro



The representativeness index is 100 %

Generating capacity

Generation expansion planning is based on the Energy Strategy Development Plan of Montenegro until 2025. There are plans for several new hydro power and thermal plants:

- HPP Morača, 238 MW installed power;
- HPP Komarnica, 168 MW installed power;
- TPP Pljevlja2, 225 MW installed power.

The installed generating capacity of renewable energy sources:

- WPP, between 80-180 MW installed power
- Small hydro power plants, 30 MW installed power,
- Other (biomass, refusion etc.), 10-15 MW installed power.

The trend of construction of renewable energy sources will continue, in order that such installed capacity enables reaching national target of 20% total electricity demand in the year 2025.

Load

According to the Energy Development Strategy until 2025, middle scenario, average annual energy consumption growth until 2025 is 1.33% yearly. Average yearly peak load demand growth will be 1.51%. Yearly percentage at the periods will be: 1.41% (2005 - 2010), 0.9% (2010 - 2015), 1.52% (2015 - 2020) and 1.51% (2020 - 2025). At the beginning of long term planning period (2010-2015) values are smaller as a result of rigour energy efficiency measures that should be taken.

Due to high influence os aluminium industry on Montenegrin power demand some mistakes in demand prediction can be expected.

Generation adequacy

During the year 2010 and after, a revitalization of two HPPs, one TPP and small HPP is planned with 868 MW installed power capacity.

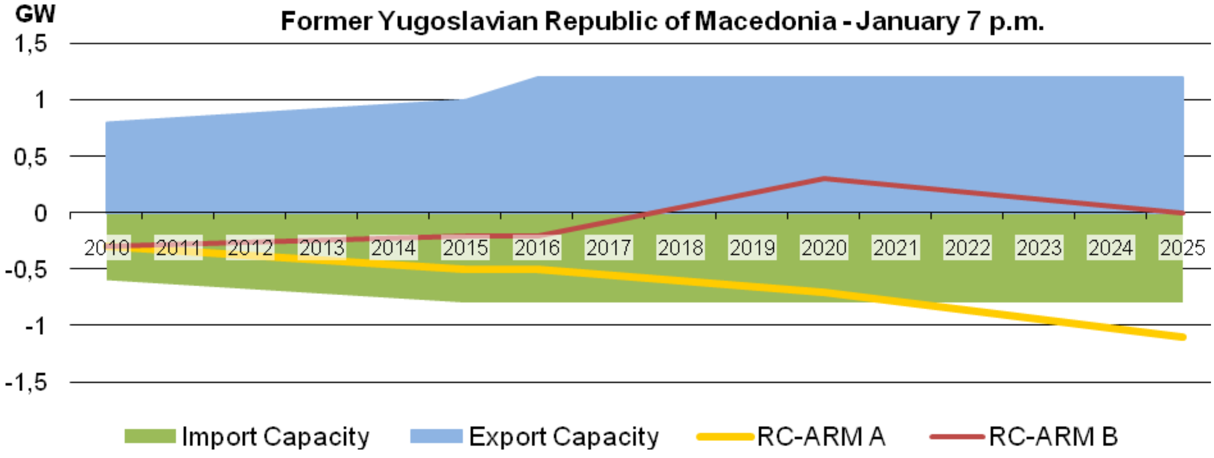
Interconnection Capacity

Montenegro will be an exporter of electricity after the year 2020. This could not be possible without the new interconnection lines. In the period of 2010-2025 Montenegro will be interconnected with Italy by HVDC undersea cable. Also OHL 400 kV Podgorica-Tirana will be constructed. There are also new OHL 400 kV interconnections as an idea between Montenegro and Serbia and between Montenegro and Bosnia-Herzegovina.

The new interconnections would increase security of supply and also capacities for transit and across border market.

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

5.25 MK - Former Yugoslavian Republic of Macedonia



Generating capacity

No comments provided.

Load

No comments provided.

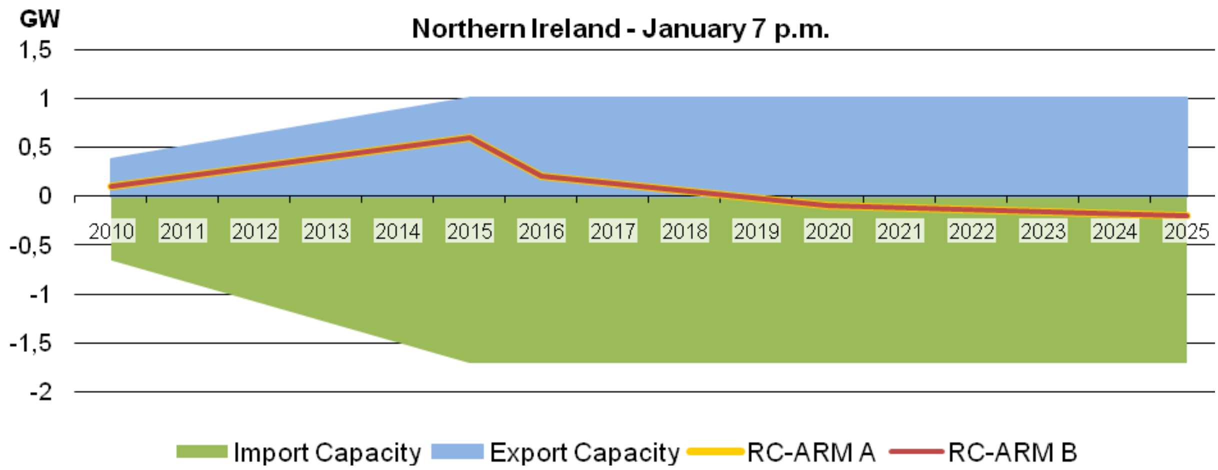
Generation adequacy

No comments provided.

Interconnection Capacity

No comments provided.

5.26 NI – Northern Ireland



Generating Capacity

Generation capacity increases in the short term due to the assumed connection of an additional CCGT plant in 2015. From 2016 onwards no generators have signed connection agreements for new plant. 2016 also sees the closure of 500MW of plant due to Large Combustion Plant Directive (LCPD).

Historically, Northern Ireland has experienced high levels of generator availability (circa 92%).

The expected increase in penetration of wind in Northern Ireland will be a challenge to manage in the short to medium term. This is expected to grow steadily in order for Northern Ireland to meet its renewable target of 40% of electricty from renewable sources. At periods of high wind and low load it may been necessary to curtail wind generation. This will be an increasingly common occurrance as more wind capacity is connected to the system.

Load

Like other TSO's, SONI have seen a drop in demand of around 4% due to the ongoing World Economic Recession. SONI expect this to level off in 2010 before returning to previously experienced growth figures of circa 1.6%. This has been included in the most up-to-date forecasts illustrated above.

Generated peak demand figures in NI can be expected to be in the region of 1850MW and normally occur in December/January at half past four p.m. (CET).

Future load forecasts are calculated using regression analysis, Average Cold Spell (ACS) correction and economic indices such as GDP and Employment figures.

Generation Adequacy

With the commissioning of a CCGT plant in 2015 Northern Ireland has a moderate generation surplus for the short to medium term. However with plant decommissioning in 2016 due to the LCPD, generation adequacy will be greatly reduced.

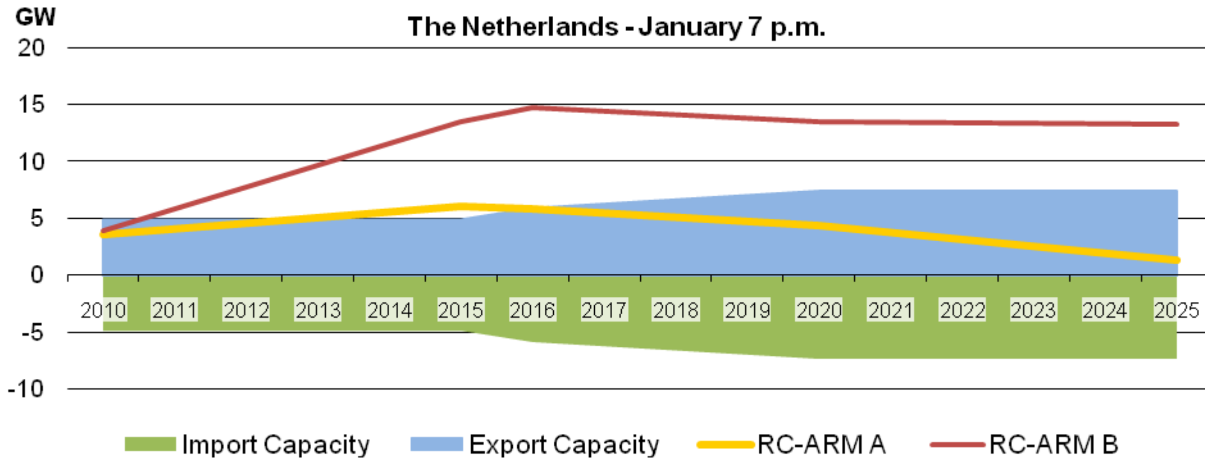
An increasing import capacity should ease the generation adequacy position, however new plant will be required in order for NI to achieve its own security standards beyond 2016. It should also be noted that over 50% of Northern Irelands generating capacity is currently over 30 years old.

Interconnection Capacity

The Moyle interconnector is a dual monopole HVDC link with 2 co-axial under sea cables from Northern Ireland to Scotland. The total installed capacity of the link is 500MW but the transfer capability is curtailed to 450MW by certain network limitations.

Post 2012 it is planned that Northern Ireland will have stronger interconnection with the Republic of Ireland via two tie-lines. Currently there is one 275kV tie-line between Northern Ireland and the Republic of Ireland with an export capacity of circa 300MW. The second tie-line will be 400KV with an export capacity of circa 1000MW.

5.27 NL – The Netherlands



Generating capacity

The general figure regarding the development of the generating capacity in the Netherlands is largely in line with the trend reported in the previous SAF. In the period after 2009 there will be a continuing increase in the amount of planned large-scale production capacity. In the past year, TenneT once again had to deal with further increases in the number of requests to connect production capacity to the electricity grid. Plans are under development for the construction of large power stations as well as numerous smaller CHP units and wind turbines. This development first became apparent in 2007. The Netherlands offers a relatively favourable climate for the establishment of enterprises, partly due to excellent supply routes for coal and other fuels, a high-quality gas and electricity grid, relatively large quantities of cooling water, substantial gas reserves and a relatively large amount of interconnection capacity. In the evolving North-western European market, energy companies are therefore opting to establish their facilities in the Netherlands.

In the latest National system adequacy forecast the following developments are reported:

- Approximately 2.3 GW of capacity is to be realised in 2010,
- 8.3 GW of capacity in the 2011-2013 time period,
- 7.7 GW of capacity in the 2014-2016 time period.

This brings the total amount of planned new capacity to approx. 18.5 GW over the surveyed period, i.e. from 2009 to 2016. This exceeds the amount of planned new large-scale capacity announced in the previous system adequacy report, which projected an increase of approx. 14.1 GW in the 2009-2015 time period. Because of these developments, the Netherlands' structural dependence on imported electricity for its security of supply appears to be coming to an end and a large export potential will be developed from 2009 onward. The trend is also reinforced in the short term because demand for electricity is currently lower than was previously forecast by market parties, due to the global economic downturn.

The effects of the crisis on plans to develop new capacity are as yet uncertain. For the time being, most of this new production capacity will have to be transmitted across the existing grid. In some locations, however, the grid does not have sufficient capacity to transmit this (new) supply of electricity at all times. We are therefore working to expand the grid's capacity. This may take several years, however, as the development of new grid infrastructure generally takes longer than the construction of new power stations. In the meantime, TenneT continues to abide by the principle that all connection requests are to be granted where possible.

In addition, TenneT is developing a national congestion management system to deal with transmission capacity shortages on the grid. Systems for managing congestion at the local level are already in operation. There are uncertainties on both the supply and demand side when it comes to developments in the next years. On the supply side, there is no certainty that all the reported projects will in fact be realised. On the demand side, there is some uncertainty about the extent to which the economic crisis will affect the demand for electricity. In the National Adequacy Forecast report, several separate 'sensitivity calculations' were carried out in order to determine the effects that anomalous supply and demand developments may have on the security of supply. Even in the most 'extreme' sensitivity variant, which assumes no reduction in demand due to the economic crisis and completion of no more than 50% of reported new construction projects (amounting to approx. 10 GW), these analyses show that a very high degree of security of supply will be achieved in 2016, with an export potential for the Netherlands of approx. 4.6 GW.

Load

Load decrease in 2010 is 0.5%. In following years it is increase 2%. The effects of the economic crisis are expected to become apparent in the development of domestic demand for electricity over the course of 2009 and 2010. Demand is currently decreasing. The development of demand in the next few years is based on an assumed direct link between the increase in electricity consumption and the economic growth forecasts published by the Netherlands Bureau for Economic Policy Analysis (CPB). This assumption results in a drop in demand of 4.75% in 2009 and 0.5% in 2010. Recovery is assumed to take place over the next few years, with a year-on-year economic growth rate of 2% and a corresponding rise in electricity consumption. The developments outlined above will result in the electricity demand decreasing by 11 TWh in 2010 compared to the demand forecast for that year made in the previous year.

Investigations by the Ministry of Economic Affairs of the Netherlands show that there´s a DSM potential of 1000-1500 MW directly related to market prices. In the figures it´s supposed that this capacity will grow gradually over the period until 2020. There are no specific tariffs to make this capacity available. Within the bid-system for reserve and regulation power of TenneT TSO BV part of this market potential can be used.

Generation adequacy

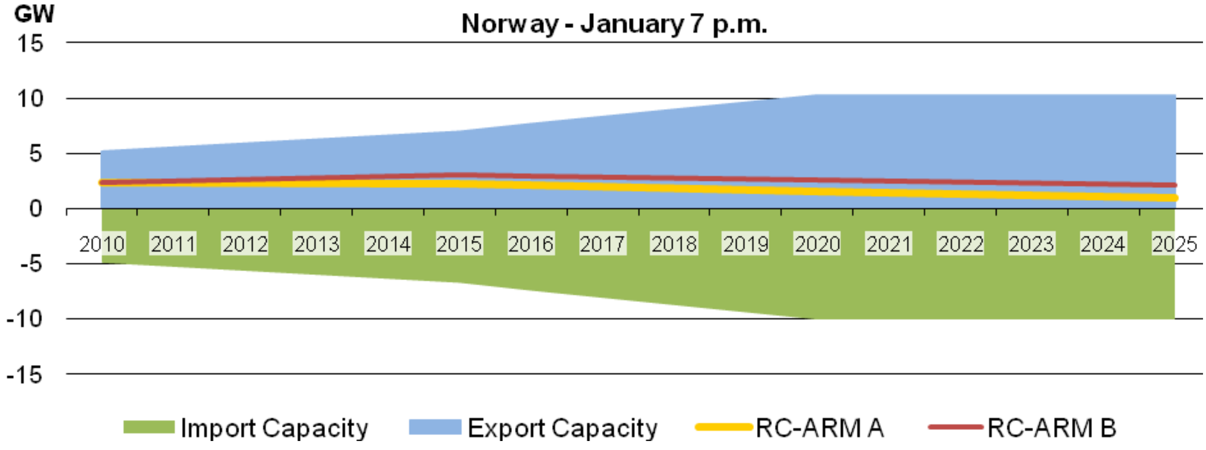
The experience of TenneT TSO BV until now is, that all contingencies were solvable with the available amount of reserve. So it appears to be sufficient resources by market parties themselves to maintain programmatic balance, meanwhile sufficient resources were left to maintain system balance in an adequate way.

The non-usable capacity in thermal plants has mainly two components: heat production in combined heat/power plants during the winter period and cooling water restrictions on occasion in summertime. For waste burning plants there is lack of waste during 25% of time. For wind power units the average production over the year at full power is nearby 25% of the capacity

Interconnection Capacity

The given values aren´t NTC-values but average operational values as agreed on with the TSO-auction partners. In these operational capacities an increase isn´t taken into account that eventually could be obtained by developing the infrastructure in networks of the neighbouring TSO´s, as far as isn´t decided about yet. The DC-cable from Norway to the Netherlands with a capacity of 700 MW was commissioned in May 2008 and has shown good results for imports. The BritNed cable between England and the Netherlands with a capacity of 1000 MW is actually under construction and can most probably be taken into service in the year 2010. The new Doetinchem-Wesel interconnection to Germany, with a capacity of 1.5 GW, will be available up from reference year 2015. TenneT is currently investigating possibilities for increasing de interconnection capacity with Denmark.

5.28 NO – Norway



Generating capacity

By 2010 the total Norwegian generation capacity is about 31000 MW. Of this, 96 % is hydro power plants, 3 % is thermal power plants and 1 % is wind power plants.

Load

It is expected that the petroleum sector will increase its load in the north of Norway, and that general consumption will increase gradually. The maximum load for Norway is expected to be about 22 000 MW in a normal winter and 23 000 MW in a severe winter (1 of 10 year, temperature)

Generation adequacy

The value of not available capacity is based on statistical observations and on these principles:

- Hydro power is 87 % available, based on historical power registrations. Most of the not available capacity is related to river-runned power plants which are rather dry in the winter. Another reason is that the lower reservoir level the lower available generation. During the winter the reservoir level is usually lower and lower.
- Wind power is 5 % available. This based on statistical observations on the different wind power plants.
- Combined Cycle Gas turbines (CCGT) are 100% available.

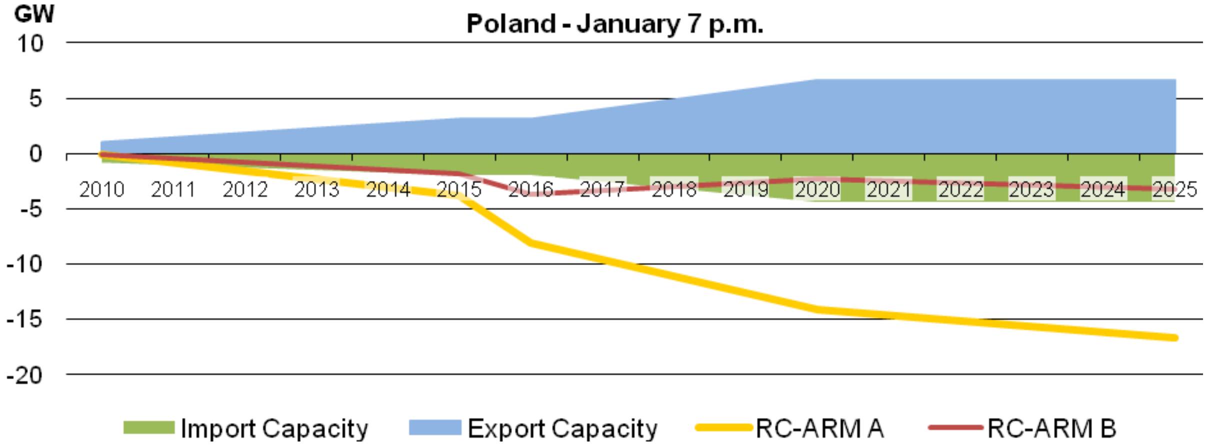
Interconnection Capacity

In scenario B the following interconnectors are included:

- DC-link to Denmark 600 MW, year 2014
- DC-link to Sweden 1 200 MW, year 2016
- DC-link to the Netherlands 700 MW, year 2015-2017
- DC-link to Germany 1 400 MW, year 2016-2018
- DC-link to Great Britain 1 200 MW, year 2016-2020.

These projects are only plans, which mean that no investment decision has been taken. The projects are mostly based on an increasing need of interaction between the hydro-dominated Norwegian/Swedish system and the wind/thermal based continental system.

5.29 PL – Poland



National representativeness is 100%. Values presented in this report are coherent with the previous one (UCTE SAF Report for the years 2009-2020). Main changes concerning load (big decrease in 2010) gain from economic and financial world crises,.

Generating capacity

At the end of the year 2010 there is planned first synchronization of the new unit with the maximum output capacity amounted 800 MW. Regular work of this unit is expected from 2011. It will be the biggest unit in the Polish power system. At the same time some shutdowns of conventional thermal units will be necessary as the result of the environmental constrains.

For the Conservative Scenario A, there is no commissioning after the year 2013, except from moderate increase in wind turbines between year 2010 and 2013. This scenario indicates potential imbalances in the situation that no new investment decisions were taken in the future.

Changes (Commissioning and Shutdown) of generating capacity presented in Best Estimate Scenario B are according to the present Development Plan accepted by Polish Regulatory Office, with some modification based on the global situation and present works on the new Development Plan submitted to Polish Regulatory Office to approval. The added capacity in conventional power stations (in general) is the result of calculations taking into account the Reserve Margin value. The increase of Renewable Energy Sources, mainly wind farms, is forecasted to reach the percentage level of electrical energy consumption in Poland given by Ministry of Economy. No “Not Clearly Identifiable Sources” is reported.

Influence of LPC Directive on generating capacity

Poland, during the negotiations of the accession to the European Union (joined 1.V.2004), achieved the derogation clause from LCP Directive (2001/80/EC), which put into effect in 2008 (for SO_2) and 2016 (for NO_X). By way of derogation clause from that directive the emission limit values shall not apply until 1.I.2016 for SO_2 and till 1.I.2018 for NO_X for selected power stations and combined heat & power plants. No derogations clause for the dust.

Polish TSO, based on producers declaration, assesses that in Poland, as the result of putting into affect the present LCP Directive as well as taking into consideration limitation of units time life, the capacity of 4GW should be decommissioned at the end of 2015 and 5GW between 2016 and 2020 (mainly till the end of 2017).

These data do not take into consideration decommissioning, which will be the result of putting into affect the new IED (amending the LPCD and the IPPCD) from 2016.

Load

PSE Operator had to update the energy consumption growth as well as load due to economic and financial world crisis. The new energy forecasts predicted that till 2016 energy consumption in Poland will be a bit lower than in the previous forecasts as the result of slow down in the economy as well as energy-saving behaviour with the Polish people. After the year 2016 the increase of energy consumption will be stronger which will be caused by changes in Polish Economy and trends to reach the EU level of energy consumption. After the decrease of load registered in second half of 2008 and the beginning of 2009 the forecasted level of load in 2010 is at about 2 GW lower than in UCTE SAF 2009-2020. In present report, Polish TSO expects that the level of load presented in previous UCTE SAF report will be reached between 2016 and 2020.

For the years 2010-2025 the potential load management is not considered.

Generation adequacy

Following the excel table there are:

1. For Non-usable capacity:
   - Technological limitation of production in combined heat and power plants (during summer season);
   - Restrictions due to cooling water temperature in some of thermal power plants (during summer season);
   - Limitations due to transmission network capacity during high temperature (during summer season);
   - Average factor of unavailability of wind generation, which amounts 75%;
   - Increase of the heat production in combined heat and power plants (during winter season).
2. For maintenance and overhauls:
   - Overhauls;
   - Long and mid-term maintenances.
3. For Outages:
   - Forced Outages;
   - Present maintenances due to unexpected faults during the start of the unit.

Outages are calculated not only on basis of statistical data, but also by taking into consideration present situation in the system.

4. For System Services Reserve:
   - Power saved for primary and secondary reserves in conventional thermal power plants;
   - Power saved in pumped storage hydropower as the intervention reserves.

In the scenario “A” remaining capacity significantly decreases, as the result of decommissioning caused by putting into affect LCP Directive 2001/80/EC (additionally no new investments after the year 2012 will be taken into account in scenario A). In the scenario “B” remaining capacity is a bit lower in comparison with present level – part of added capacity results from reconstruction activities mostly connected with environmental upgrading. The most stressed period there will be years 2016-2020 – decommissionings will be necessary (till end of 2015 and till end of 2017) but new interconnection import capacity will not be activated jet.

For Poland the representative season for winter are December, January and February (peak load takes place at 17:15). For summer it is the period between second half of May and first half of August (peak load takes place at 13:15). Statistically before and after this period the daily peak load takes place in the afternoon, so the comparison of them with morning peak load at 11 a.m. will be misleading. Values provided by PSE Operator are constant at the forecasted period and base on statistical data as well as present trends in the system.

Interconnection Capacity

There is more precise information concerning SITC of Polish profile in the table below:

MW	2010	2015	2016	2020	2025
PL->DE/CZ/SK 1)	1000/900 2)	2500	2500	5000	5000
DE/CZ/SK ->PL	0	500	500	2500	2500
PL->UA 3)	0	0	0	0	0
UA->PL	220	220	220	220	220
PL-LT 4)	not applicable	0	0	1000	1000
LT-PL	not applicable	600	600	1000	1000
PL->SE	0	600	600	600	600
SE->PL	600	600	600	600	600
PL export	1000/900	3100	3100	6600	6600
PL import	820	1920	1920	4320	4320

Values presented in the table do not take into consideration planned switching (off of the internal/international lines. The real values could be lower.

1) PSE Operator S.A. gives aggregated data for the whole synchronous PL - DE/CZ/SK profile.

2) Winter/summer season

3) Radial connection at the moment. There is prepared the feasibility study concerns synchronous interconnection of the Ukraine and Moldavia with Continental Europe.

4) Back-to-back connection.

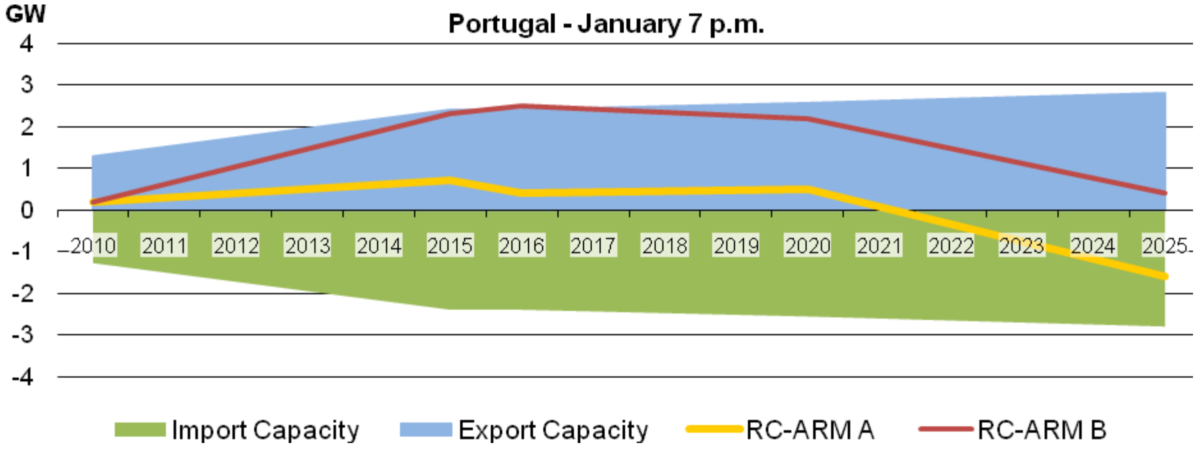
The increase of SITC in 2015 for synchronous profile will be the result of phase shifters installation in Krajnik and Mikułowa substations (connected PL and DE systems) and change the voltage level for the line Krajnik - Vierraden from 220 kV into 400 kV.

Another increase of SITC for this profile, in 2020, will be the result of building a third 400 kV line between PL and DE and second 400 kV line between PL and SK.

3x20 targets

Poland is planning to reach the EU's climate and energy policy, however for percentage using of RES the target level amounts 15%, according to the directive 2009/28/EC.

5.30 PT – Portugal



During 2010, the representativeness of Portuguese System should be equal to 99,2%, due to residual auto-consumption of some CHP generators. Beyond 2010 it is expected to be 100% since all the energy generated by CHP should be delivered to the grid.

Generating capacity

During 2010-2015, the commissioning of new 3350 MW licensed combined cycle gas turbines is expected, while all the old oil units will be decommissioned (~1800 MW). Following government's target of 45% of consumption supplied by RES in 2010, a total of 6750 MW in wind farms is expected by 2015. Regarding large hydro capacity, nearly new 2000 MW are to be installed until 2015, of which 1450 MW are mixed pump-storage. Conservative scenario includes postponements of 830 MW of a new CCGT power plant to period 2017-2020, of large hydro and of renewable capacity (mainly wind power). The EU "20-20-20" objectives will represent for Portugal a 31% share of energy consumption based on RES. That shall represent, for the electricity sector, a target of 60% of consumption supplied by RES generation. These goals should be met by increasing RES capacity and large hydro capacity. "Not Clearly Identifiable Energy Sources" refers to non renewable CHP and Urban Solid Wastes.

Load

The energy consumption forecast is based on estimations enabling the compliance of the "National Action Plan for The Energy Efficiency", that defines for the electric sector a total amount savings of 7% of consumption in 2015, 6% in 2020 and 5% in 2030.

Generation adequacy

In both scenarios, Remaining Capacity should stay above ARM, except for Scenario A in 2025, due to decommissioning of all existing coal power plants and an old CCGT plant. However these decommissioning processes are assumed to happen along with no unconfirmed investments (to replace or built new thermal capacity), which is unlikely to occur.

According to the last 4 years of demand data, Margin Against Seasonal Peak Load is assumed to be 10,3%, 5% and 8,9% of peak load, on January 3rd Wednesday at 11 a.m., January 3rd Wednesday at 7 p.m. and July 3rd Wednesday at 11 a.m., respectively.

Non-Usable Capacity:

- Wind Energy – reflects the average lack of wind power (70%);
- Hydroelectric energy (large power stations) – reflects the average lack of primary energy along with the incorporation of new mixed-pump power plants;

- Thermal RES and CHP (small independent producers) – reflects the average amount of capacity not being delivered to the grid, based on historical values

Outages:

- The larger unit installed in the Portuguese system was assumed

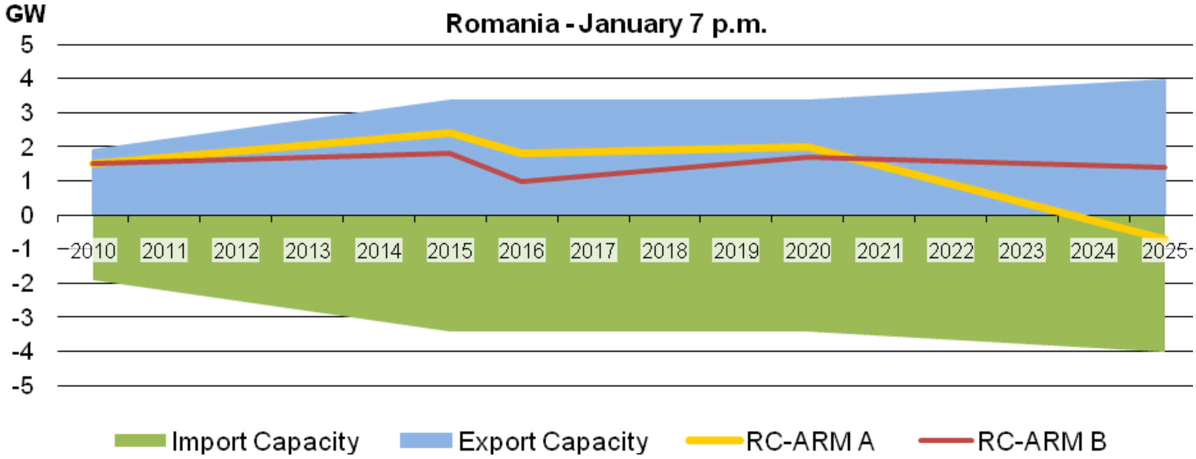
System Services Reserve:

- 2% of peak load to face load forecast uncertainties;
- Expected sudden decrease of wind power within 1h period (this criterion has revealed more accuracy than the recommended secondary control reserve empirical functions).

Interconnection Capacity

The Iberian Electricity Market (MIBEL) requires interconnection capacity capable of enabling the required market energy exchanges, in both directions and with limited grid congestions. REN and REE have several investment projects in progress that will enable the overcome of existing congestions and, beyond 2014, a total interconnection capacity of 3000 MW between Portugal and Spain. Simultaneous Interconnection Transmission Capacity was calculated based on 80% of expected NTC between Portugal and Spain.

5.31 RO – Romania



The national representativeness of this report is 100 %.

Generating capacity

The impact of the LCP Directive 2001/80/CE was considered in the evolution of the existing generating capacity, through the decommissioning and rehabilitation programs of the lignite and hard coal power plants.

Load

After the year 2010, which is expected to achieve almost the same consumption as in 2009, the increase in the electricity consumption restarts in 2011, corresponding to an average growth rate of 2.3% yearly for the period 2010-2025.

There is a regulatory frame regarding the load reduction, but in spite of this there is not any solicitation to license the consumers yet in order to balance the system.

Generation adequacy

The figures of Remaining Capacity in Scenario A and B reveal that in generating capacity no investments are required. However, in 2020 it is expected to be put in operation the third and the forth nuclear power unit.

Non-usable capacity includes temporary limitation of capacity in hydroelectric power stations, lack of wind in wind power stations during certain seasons, limitation of electrical capacity direct related to the heat extraction needed in the combined heat and power plants, high temperatures of the cooling agent in thermal power plants, utilisation of coal with low calorific power, retrofitting programs and other temporary limitations.

Interconnection Capacity

Commissioning:

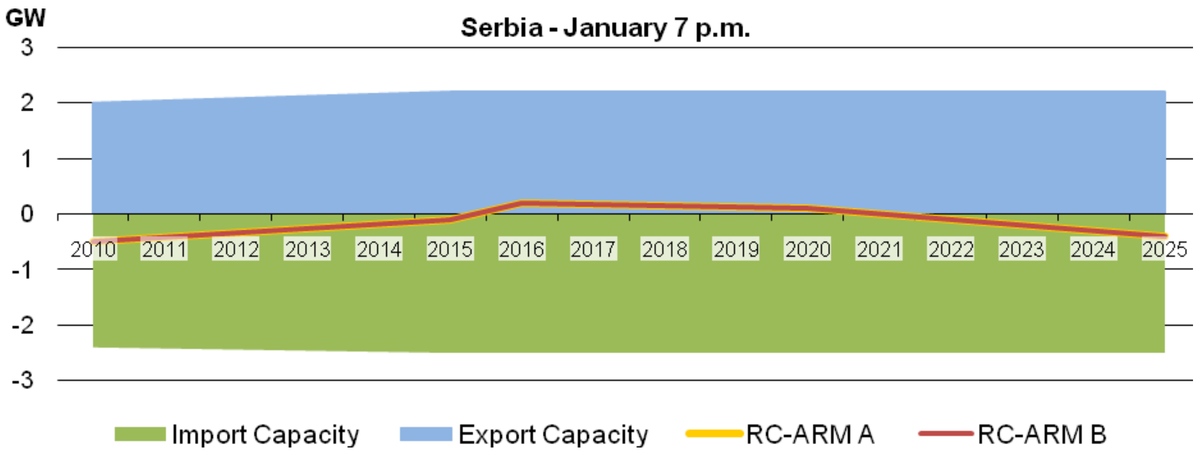
- Year 2013: 400 kV OHL Medgidia (RO) – Varna (BG); 54km, single circuit, AC line
- Year 2014: 400 kV OHL Resita (RO) – Pancevo (Serbia); ~ 100 km, single circuit, AC line
- Year 2014: 400 kV OHL Medgidia (RO) – Dobrudja (BG); 72.5 km, single circuit, AC line
- Year 2020: 400 kV OHL Suceava (RO) – Balti (MO); 150 km, (93km in RO); single circuit, AC line

Decommissioning

- Year 2013: 400 kV OHL Isaccea (RO) – Varna (BG);
- Year 2014: 400 kV OHL Isaccea (RO) – Dobrudja (BG).

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

5.32 RS – Republic of Serbia



Energy potential, hydro and lignite, has influenced on development of generation capacity with a view to fulfil most of electricity demand of Serbia.

Generating capacity

It is not expected construction of new hydropower stations during next ten years. Some small hydropower stations are planned to build, but their influence on system will be negligible. Capital operations on existing hydropower stations are planned and that will increase performance of units.

Thermal units will have noticeable changes. Existing gas turbines combined cycle PP Novi Sad will be replaced with the new one of 360 MW till 2015. Next thermal plants will get new units:

- Kolubara B 2x350 MW till 2015
- Nikola Tesla B 700 MW till 2016
- Kolubara A 200 MW till 2019
- Kostolac B 450 MW till 2021

It is expected that some of existing units will be decommissioned. The plan is that during next ten years 1 GW will be decommissioned.

Unit, which aren't in operation for several years, are considered as non-usable capacity. Values for maintenance and overhauls are taken from PC "EPS" repair plan. Average outage power for winter period is taken for outage. System reserve is evaluated according to the new adopted rules and real situation that showed us that we cannot arrange more than 450 MW.

Load

Values for load are calculated assuming that weather conditions will be normal.

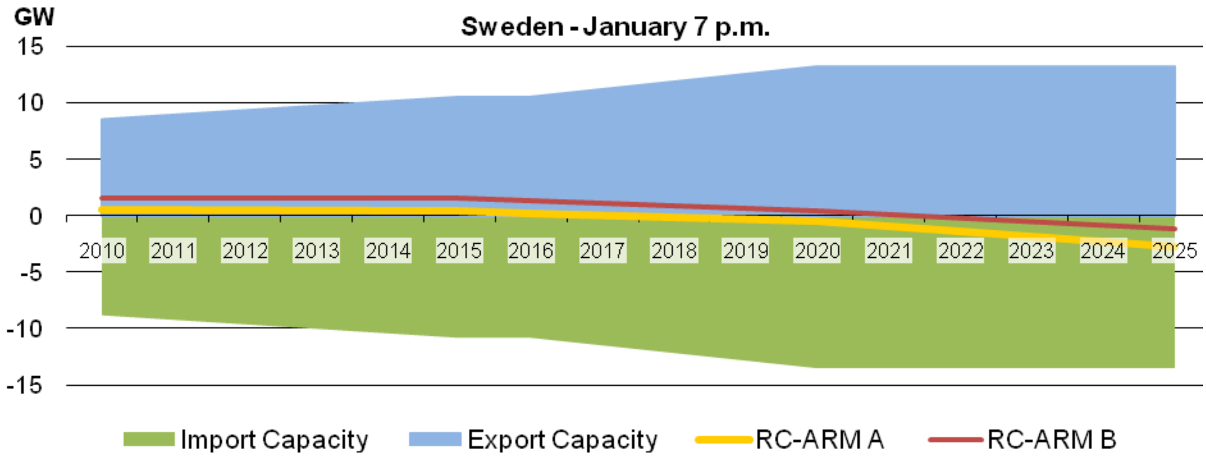
Generation adequacy

No comments provided.

Interconnection Capacity

No comments provided.

5.33 SE – Sweden



Generating capacity

Data for NGC Hydraulic Power is not divided in respectively category. Within NGC Fossil Fuels all mixed fuels power plants consist of renewable (bio fuels etc.)

Some capacity will be unavailable, some is under maintenance and some is a part of the reserve. For wind power 94% of the capacity is calculated to be unavailable because of the uncertainty of the wind (a statistical figure - we can always count on 6% of the mills will produce power).

Load

Load forecast is built on a peak load for a normal winter and summer. The post ´load´ consists of expected peak load as an average value of an hour and not as a peak value of an hour.

Load management consists of load that can be disconnected.

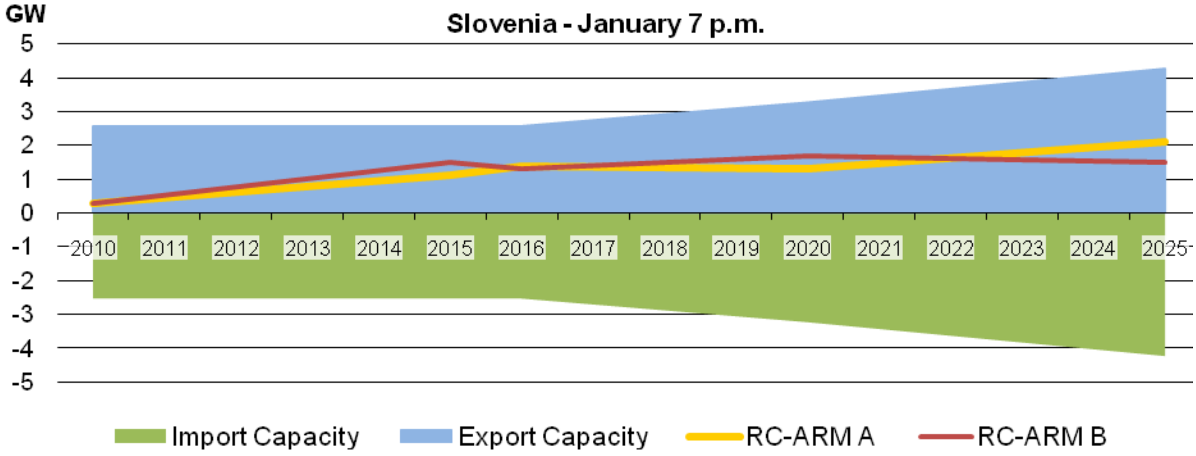
Generation adequacy

No metering data for peak of an hour exists; data only exists for average of an hour.

Interconnection Capacity

Given data is total trade capacity that can be used.

5.34 SI – Slovenia



Representativeness index equals 95% (year 2008) due to a limited access to data on the distribution network. The other 5% of NGC represents distributed generation on distribution network. The 95/5 ratio refers to energy production in 2008.

Generating capacity

The generating capacity increases due to new hydro units on middle and lower Sava river, 2 pump-storage units on Soca and Drava river, new lignite thermal unit in Sostanj and gas units in Brestanica, Trbovlje and Koper. Higher Wind power is expected in Best estimated Scenario B. The scenario B involves new unit in nuclear power plant Krsko. Decommissions in both scenarios arrives at the end of thermal units life time.

Nuclear power plant Krsko: The table considers 100 % of its generation capacity although ownership of the nuclear power plant Krsko is equally divided between Slovenia and Croatia, thus half of its generation is delivered to Croatia in accordance with the international agreement.

Load

Energy forecast is mainly based on GDP growth and demography development. In the GDP forecast "U-shaped" economic recession is predicted. No major evolutions in demography are expected in the period 2010-2025.

Generation adequacy

Remaining capacity increases over the whole period in both scenarios.

The peak load in summer will increase faster than in the winter however annual peak load is expected in winter in the whole period.

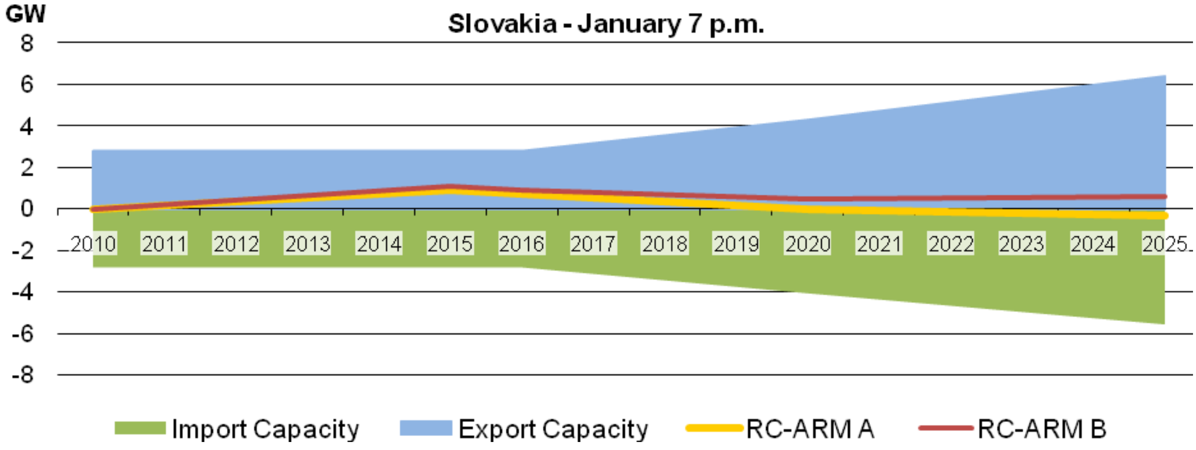
A Non-Usable Capacity arrives mainly from lower availability of the primary energy source in hydro power stations and wind.

The reserves increase dramatically due to commission of new lignite unit in Sostanj and new nuclear unit in Krsko, hence higher tertiary reserves are required.

Interconnection Capacity

SITC increases due to new PST on Italian 400 kV interconnector, new 2x400 kV internal line Bericevo-Krsko and new 2x400 kV interconnections with Hungary and Italy.

5.35 SK – Slovakia



Generating capacity

Slovak generation mix is stabile in all monitored periods. After final decommissioning of Jaslovske Bohunice Nuclear Power Plant V1 (440 MW), in the year 2008, the Slovak Republic became slightly dependent on import of electricity. In next years the generation vs. load balance of Slovak power system is almost stabile in both scenarios (situation is better in Scenario B). After 2014 there is expected some decommissioning of older thermal power plant units (880 MW total) due to their lifetime, economic issues and environmental issues (LCP Directive) and in Scenario A also decommissioning of NPP Jaslovske Bohunice V2 due to its lifetime (after the year 2020). In the Scenario B this NPP is considered as able of operation after its lifetime prolonging.

On the other hand there are expected new power plants:

Scenario A:

- Finishing of a building Nuclear Power Plant Mochovce, units 3 and 4 – year 2013
- Installed capacity increasing in Nuclear Power Plant Jaslovske Bohunice, unit V2 – up to the year 2010
- Installed capacity increasing in Nuclear Power Plant Mochovce, units 1 and 2 – done in the year 2008, however influence of that increasing is visible in this forecast as well
- New Combine Cycle Power Plant in Malzenice and Panicke Dravce – both in year 2010 (430 MW and 50 MW respectively)
- New oil power plants (combusting oil fuel) – few units within Slovakia (Levice, Sucany, Moldava), together 87 MW (brutto); expected date of termination 2009
- New thermal power plant – place not sure yet, after 2020, about 400 MW

Scenario B - as in Scenario A plus

- New thermal power plant in 2015 – 200 MW
- New thermal power plant between 2016 and 2020 – 200 MW

Renewable energy sources development is considered the same in both scenarios, based mainly on wind and solar power plants.

Load

Due to economic and financial crisis the load increase is not as optimistic as in previous UCTE SAF Report. The difference is visible mainly in the year 2010 when the decrease is the biggest. However in following years load decrease is expected as well comparing with previous report, but it is not so significant.

This remark is true for both scenarios.

Generation adequacy

Generation adequacy should be maintained during whole monitored period and in both scenarios mainly with help of new generation units. In case of generation insufficiency the load will be covered by exports.

Maintenance and overhauls are planned according to the experiences from previous years, based on historical data for each generation technology.

From 2009 there is new methodology for System Service Reserve assessment. Therefore the values of this parameter are slightly higher in both scenarios than in previous report.

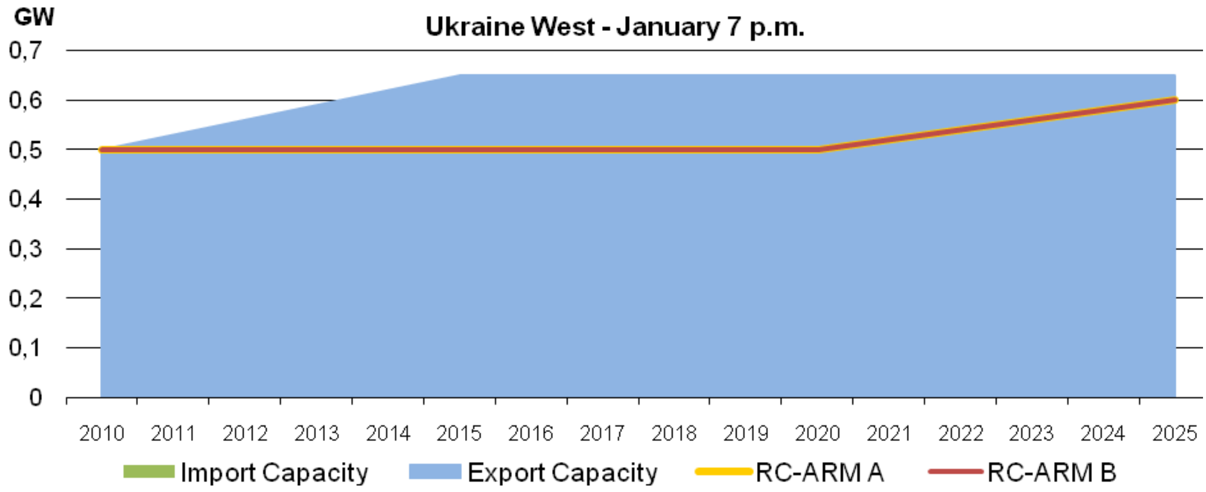
Concerning Adequacy Reference Margin or Spare Capacity parameter, in Slovakia they are not considered as the definition was not understandable. However the discussion about this parameter will continue and in the future reports we expect to provide this values as well.

Interconnection Capacity

Scenario A is more pessimistic in SITC development expectations. New interconnection with Hungary is expected in 2025 only. In Scenario B they are expected two new interconnections with Hungary and in 2025 there is new interconnection between Slovakia and Poland and Slovakia and Ukraine-West assumed.

It is important to point out, that all these projects are in process of joint discussions between TSOs concerned.

5.36 UA-W – Ukraine-West



Generating capacity

"Burshtyn Island" was created in 2002. This "island" comprises:

- Burshtyn thermal power-station with 12 power units for 200 MWt of set power;
- Kalysh heat and power plant with 4 power units of 50 MWt of set power, but disposed power of about 40 MWt
- Tereblia-Ricskaja waterpower plant with available power of 27 MWt and also a few small power-stations which belong to the consumers.

Load

No comments provided.

Generation adequacy

No comments provided.

Interconnection Capacity

No comments provided.

6. Role of Interconnectors

National Analysis

As described in the methodology section 2.3, a simplified way to analyse the potential role of transmission capacities of the national systems under most of the situations, is to compare Remaining Capacity minus Adequacy Reference Margin to Simultaneous Interconnection Transmission capacity.

When Remaining Capacity minus Adequacy Reference Margin is negative and its absolute value is lower than Import Capacity, it means that all the necessary import flows to meet load can be imported in most of the situations.

Any positive Remaining Capacity minus Adequacy Reference Margin represents extra capacity potentially exportable in most of the situations, to be compared to simultaneous export capacity. However RC-ARM over SITC does not necessary mean calling for additional transmission capacities, as many uncertainties are to size the real capacity:

- The merit order of the units in both side of the borders are definitely to be considered, what is not the case here;
- RC includes Load Management but will it be activated to export?
- Additional transmission projects are already under study;
- Uncertainties regarding the decommissioning and the actual installation of new power plants;
- Adequacy Remaining Margin calculation is not accurate enough to be used as a criteria to size transmission capacities;
- Tertiary reserve for own system service reserve, which cannot be exported, has not been considered (not in all countries);
- Internal congestions on the borders have not been taken into account.

In 2010, Spain, Great Britain and Republic of Ireland seem unable to export all their extra capacity under most of situations. However one shall not conclude from that single comparison that additional transmission capacity is required. Actually Remaining Capacity minus Adequacy Reference Margin takes into account Load Management, which might not be activated by the stakeholders to secure exports. Then the economic consistency of such exports would have to be analysed.

Among the major contributors with positive RC-ARM, France and Germany can export all of it, whereas Spain and Great Britain cannot. Italy has not reported any Export Capacity while Austria did not report any value or comments.

In 2010, countries that are likely to rely on imports when considering most of the situations include: Bosnia-Herzegovina, Finland, Greece, Hungary, Latvia and Former Yugoslavian Republic of Macedonia, Poland and Serbia. RC-ARM is also negative in Cyprus and worsens until 2016.

In spite of this, Bosnia-Herzegovina, Greece and Hungary are expected to become potential exporters in 2015. Serbia reaches positive RC-ARM in 2016. The same applies for Latvia although only valid in Scenario B.

On the other hand, in 2016 and beyond, transmission capacity will become crucial for Belgium and Denmark that will shift from potential exporters under most of the situations to potential importers. In the case of Estonia that happens just for one year period (if not considering Scenario A). In the very long run, best estimations also point Republic of Ireland and Sweden as relying on imports.

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

Some countries may face some difficulties due to either insufficient extra generation capacity in neighbour systems or lack of interconnection capacity.

This may be the case of Bosnia-Herzegovina that, although expects to become a potential exporter from 2015, in the meantime may not get enough help to face extreme conditions, through imports from Croatia and Montenegro, due to tight surplus in these countries.

From 2010, Poland faces significant RC reductions as result of decommissioning due to environmental constrains. In 2016, this may result in insufficient interconnection capacity to imports under most of situations. PSE Operator has changed the forecasted level of SITC, however the RC incl. import capacity in 2016 is still negative.

7. General Conclusion

The SAF Report (System Adequacy Forecast Report) was prepared based on input data provided by TSOs/national data correspondents (at the end of September 2009) and covers the time period from 2010 to 2025.

The Net Generating Capacity (NGC) is increasing until 2015 in both scenarios, with a small exception in Scenario A between 2015 and 2016 when there is a small decrease (-3 GW). The final level of NGC in 2025 in Scenario A is 1010 GW and in Scenario B it is 1238 GW. The main difference between the two scenarios is a higher commissioning of new generation capacity in Scenario B. In Scenario B, a more optimistic increase of renewable energy sources as well as of new gas power plants is expected.

Load is expected to increase throughout the period 2010-2025. The same applies to consumption. The biggest annual average energy consumption growth is expected in Cyprus, Slovenia and Bulgaria in all monitored time periods. The total energy consumption growth from 2010 to 2025 for the whole ENTSO-E is 886 TWh. At the same time, for the whole ENTSO-E area, the expected total load growth is about 115 GW from 2010 to 2025.

However, due to the economic and financial crisis, this increase could be influenced by some uncertainty, mainly in the period 2010-2015.[22].

Of all primary energy sources, the biggest development is reported for Renewable Energy Sources (excluding hydro generation) and fossil fuels. The increase in RES capacity (excluding hydro) is a confirmation of the data reported in earlier analysis. This type of generation is actively stimulated through EU policies as well as national policies. National governments usually encourage the development of RES (excluding hydro) by implementing policies such as advantageous feed-in tariffs or special conditions for access and connection to the grid or other additional subsidies.

The increase in RES capacity (excluding hydro) corresponds mainly with the wind farms development. RES capacity (excluding hydro) is increasing in both scenarios and in all reference points. In Scenario A the annual average growth of RES capacity (excluding hydro) is 6.02% per year (total increase about 140 GW up to 2025) and in Scenario B it is 7.95% per year (total increase about 218 GW). The main contributors to this increase in RES (excluding hydro) between 2010 and 2025 are Germany (45.8 GW), Spain (39.9 GW), France (26.8 GW), Italy and Great Britain (both about 17.5 GW).

The main developing capacity of fossil fuels are gas power units. This increase is continuous from 2010 to 2025. It is 23% in total in Scenario A and 39% in Scenario B. However, the given numbers do not necessary reflect the actual usage of gas power units. The Netherlands and Cyprus are leaders in the installed capacity of gas power units as a part of NGC (67% in 2015 and 2020 for the Netherlands; 67% and 82% for 2015 and 2020 respectively for Cyprus), followed in both monitored years by Hungary with almost 50% in 2015 and 2020, the Republic of Ireland having a share of 50% in 2015 and 42% in 2020. Great Britain and Belgium have a share of about 40% in both these years.

The report notes that the Generation adequacy in Scenario B should be maintained during the monitored period. In Scenario A, generation adequacy is maintained until 2020. After this term, new generation capacity could be needed to achieve at least the same level of adequacy as in 2010 (about 193 GW of additional new generation capacity is needed that is not yet certain). In Scenario B generation adequacy is maintained all the time in any reference point. In January at 7 p.m, in the year 2025, there is surplus about 37.4 GW in generation capacity (assuming the same level of adequacy is needed as in 2010)[23]. In other reference points it is even higher.

---

[22] *For more information see paragraph 3.1.*

[23] *For more information see paragraphs 3.2.6 and 3.3.2*

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

8. Appendices

8.1 Calculation of EU 3x 20 indicators

Two 3x20 indicators were calculated using the data collected for this SAF report, namely a RES generation indicator and a CO_2 emissions indicator. The following paragraphs describe the performed calculations.

8.1.1 RES generation indicator

The proposed RES generation indicator is simply the ratio of the generated power from Renewable Energy Sources by the electric consumption in 2020. In order to construct this RES generation indicator, the following data is needed:

a) the electricity energy consumption in 2020

b) the RES production in 2020

The ENTSO-E and EU (without Malta) electricity consumption in 2020 is calculated at, respectively 4004 TWh and 3657 TWh.

In order to calculate the RES production in 2020, the information related to Net Generating Capacity needs to be combined with equivalent running duration per type of generation.

As stated before (see paragraph 3.2.4) hydro generation is a major part of the foreseen RES production, it poses a special challenge since the pure pump storage part is not recognized as RES. However there are hydro power units that combine the possibility of pump storage with natural inflow. Hence TSOs are not always able to identify if the hydro capacity can be classified as a RES capacity, although this is not true for actual generation. For the calculation of the RES generation indicator the installed capacity of hydro units was reduced by the installed capacity of those units identified as pure pumped storage as well as not clearly identifiable. The following table gives the installed generation capacity of RES per generation type for 2020.

	NGC (in GW)
Wind (ENTSO-E)	198
Wind (EU without Malta)	194
Solar (ENTSO-E)	38
Solar (EU without Malta)	38
Other RES (ENTSO-E)	26
Other RES (EU without Malta)	23
Hydro (without pure pumping and not clear hydro) ENTSO-E	172
Hydro (without pure pumping and not clear hydro) EU without Malta	118
Total RES (excluding pure pumping and not clear hydro) ENTSO-E	**434**
Total RES (excluding pure pumping and not clear hydro) EU without Malta	**374**

By definition, the yearly output of renewable units may vary from one year to another because of climatic conditions, with possible variations from one country to another one complying with different primary source of energy potentials. However, for a given country, or set of countries, the equivalent running time for every RES category (wind, hydro, solar) remains quite stable on a few years average.

The equivalent running hours of the different type of RES units were determined based on System Adequacy Retrospect materials that were collected in the framework of former UCTE with exception of the equivalent running hours for hydro for Norway and Sweden that are based on national correspondent's insights:

- All hydro (except for Norway and Sweden): 2700 h/yr (but pumped storage);
- All hydro for Norway and Sweden: 4200 h/yr (but pumped storage);
- On-shore wind: 1800 h/yr;
- Off-shore wind: 3500 h/yr ;
- Solar: 620 h/year (based on SAR 2008 data)
- Other RES (biomass, waste, …): 5200 h/year (based on SAR 2008 data)

For Regional Blocks, whose climatic conditions deviate from this former UCTE average, yearly equivalent running duration may differ.

An additional hypothesis was made concerning the division between onshore and offshore windmills. No specific information regarding this division is collected for the SAF report. However, the equivalent running hours for onshore and offshore windmills are quite different. It was assumed that the EWEA suggested target of 40 GW for 2020 is reached. Hence 21% of the wind capacity was considered as offshore wind with 3500 equivalent running hours and 79% of the wind capacity was considered as onshore wind with 1800 equivalent running hours.

The combination of the above mentioned information leads to the assessment that in 2020 the RES production may reach production levels of approximately 1193 TWh for ENTSO-E and 933 TWh for the EU (without Malta).

This very rough estimation leads to the conclusion that the share of RES production in the electricity consumption of ENTSO-E and the EU (without Malta) is foreseen to be respectively 29.8% and 25.5% in 2020.

8.1.2 CO_2 emission indicator

The proposed CO_2 emission indicator is a simplified approach that assumes that a representative average CO_2 content per MWh can be relied upon. The amount of CO_2 emission from electricity production is derived by multiplying the amount of electricity consumption not compensated by RES or nuclear production by and a representative average CO_2 content per MWh. The proposed indicator only reflects the CO_2 emissions resulting from the generation of electricity and does not include the other greenhouse gases that can be expressed as a CO_2 equivalent. Furthermore the indicator is a very rough estimation.

In order to construct the CO_2 emission indicator, the following data is needed:

a) the electricity energy consumption in 2020

b) the CO_2 free production in 2020 (RES production + nuclear production)

c) a representative average CO_2 content per MWh

With the exemption of the nuclear production and the representative average CO_2 content per MWh, the needed data is already calculated in order to estimate the RES generation indicator.

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

The Nuclear production is estimated by multiplying the installed capacity of nuclear units in ENTSO-E and the EU (without Malta), respectively 128 GW and 125 GW, by the equivalent running hours for nuclear units.

Nuclear power plants are typical base-load units, with relatively high fixed, mainly investment costs, but relatively cheap variable operating costs, and requiring rather high equivalent running time to be profitable. The equivalent running hours is estimated at 6900 h/yr for nuclear power units based on former UCTE System Adequacy Retrospect material.

The representative average CO_2 content per MWh is based on assessments of the primary fuels' typical energy and the CO_2 content as well as the typical efficiencies of power plants. In order to avoid assumptions on which type of fossil fuel that will be used for the electricity consumption not compensated by RES or nuclear production, an indicative range can be used. Therefore an average internal content for thermal generation production of 0.4 t CO_2/MWh (which would correspond to 100% gas, or equivalent fossil fuel mix), as well as 0.8 tCO_2/MWh (which would correspond to 1/3rd gas and 2/3rd lignite and hard coal, or equivalent) were used.

Combing the above mentioned parameters, the CO_2 emissions from electricity production are estimated between 770 and 1540 Mt CO_2 emissions for ENTSO-E and between 744 and 1488 MtCO_2 emissions for the EU (without Malta) depending on whether the thermal production is assumed to come 100% from gas or only 1/3 from gas and 2/3 from coal or lignite.