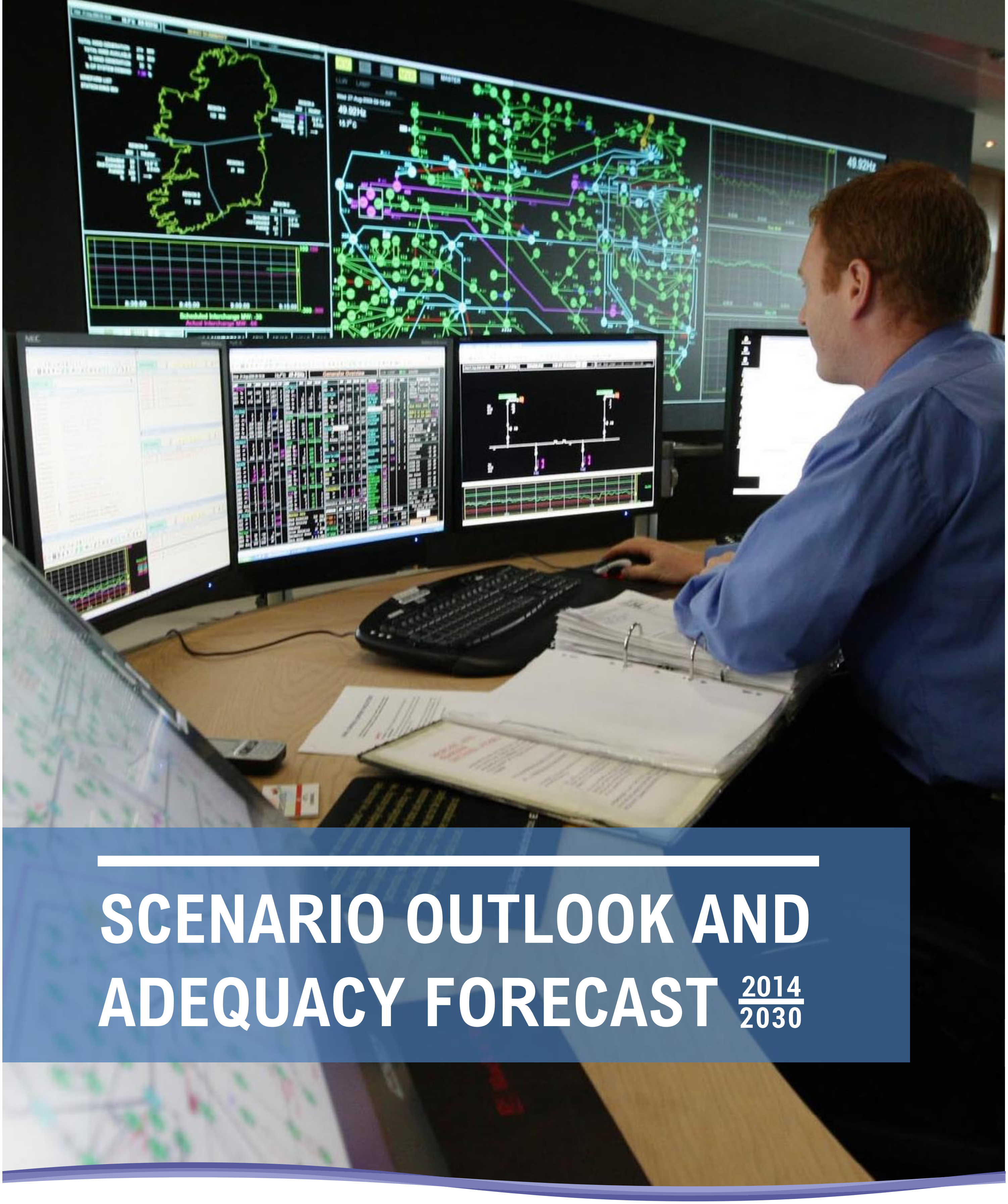

SCENARIO OUTLOOK AND ADEQUACY FORECAST 2014/2030

European Network of
Transmission System Operators
for Electricity

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1. Executive summary

The Scenario Outlook & Adequacy Forecast (SO&AF) is the ENTSO-E annual publication, and presents the scenarios included in the Ten-Year Network Development Plan (TYNDP) in compliance with Regulation (EC) n. 714/2009. It also assesses the adequacy between generation and demand in the ENTSO-E interconnected power system on mid- and long-term time horizons.

This SO&AF 2014 report is published as part of the TYNDP 2014 package. It sets out 3 scenarios for generation and demand:

- the ñEU2020ò scenario is derived from the National Renewable Action Plans (NREAP) in compliance with the European 3x20 objectives or from other governmental / national documents / policies;
- Scenario B (ñBest Estimateò) is based on the expectations of TSOs;
- Scenario A (ñConservativeò) is derived from Scenario B, taking into account only the generating capacity developments which are considered secure.

SO&AF 2014 also contains quantitative data on the four Visions used for 2030 assessments, providing a bridge between the EU energy targets in 2020 and 2050. The four visions are based on distinctively different assumptions, thus the actual future evolution of parameters is expected to lie in-between. This conceptual difference to the 2020 scenarios is also reflected in the method of data presentation used.

Visions 1 and 3 assume a relatively low level of integration of the European energy market, and thus are based on national data (bottom-up), with Vision 1 assuming a general delay in progression towards 2050 energy roadmap goals, while Vision 3 is constructed to be ñon trackò towards these policy goals. The results of top-down Visions 2 and 4 are in contrast based on a well-functioning and strongly integrated market being constructed at a European level. The detailed assumptions of each vision are described in Chapter 7.

1.1 Main results – load and generation

Load in Scenario Best Estimate (B) increases continuously in both reference points - January and July (Figure 1.1 a and b.). Scenario A used in this report shows the firm generating capacity to be built and known to TSOs, aiming at identifying the investment needed in the period to maintain the level of adequacy. It is recommended that the load and decommissioning for both scenarios be assessed using the same initial criteria.

Average forecast rate of load growth during the period 2014-2025 is approximately 0.9%, with initial low growth rates foreseen for the first years of the period and accelerating towards annual growth values above 1% from the end of this decade.

Between 2014 and 2025:

- Great Britain is the only country expecting a minor decrease in load (-0.41%);
- The highest annual increase is expected in
  - Montenegro (+5.49%)
  - Slovenia (+3.22%).

On a European level, the growth of summer reference load is markedly faster than that of the winter load, thus reducing the difference between the two. On a country level, large differences can be observed with regard to the relation of the two values as well as the growth rates, due to widely different climatic characteristics.

Scenario B has been revised compared to SO&AF 2013, foreseeing lower initial load values and lower growth rate in the first years of the period assessed, mainly as a result of the prolonged effects of economic crisis. The revised EU2020 Scenario corresponds to a growth of load very close to the best estimate (Scenario B).

Load growth is projected to continue at an accelerating rate between 2025 and 2030 under the assumptions of the more optimistic Visions 3 and 4, while Vision 1 and 2 foresee very similar load values in 2030 to those in 2020 and 2025, respectively.

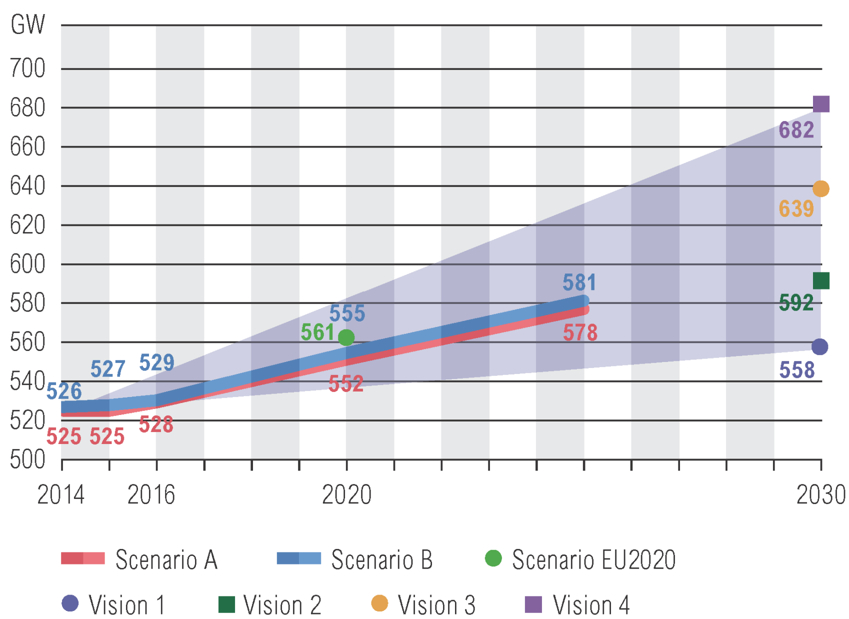

Figure 1.1a. Load (all Scenarios, January; GW)

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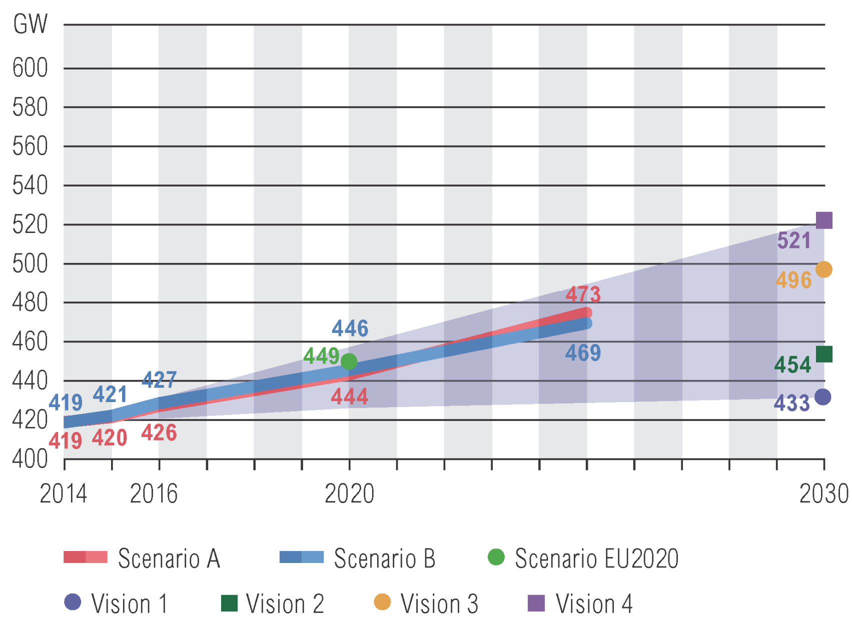

Figure 1.1b. Load (all Scenarios, July; GW)

With regards to generation capacity:

- The most rapidly developing energy sources are renewables. In Scenario B, their built-in capacity increases by 60% in 11 years (379 GW in 2014 to 608 GW in 2025).
- Fossil fuelled generating units are forecast to have a decreasing weight in the generation mix, with an approximate decrease in capacity of 8.5% until 2025.
- Nuclear built-in capacity is expected to stagnate until 2020, with a slight decrease until 2025.

The main difference in Scenario EU2020 can be observed in a higher RES capacity, compensated by lower amounts for fossil fuels. In other categories, EU2020 scenario results on a European level are similar to those of Scenario B; however, differences in individual countries may occur.

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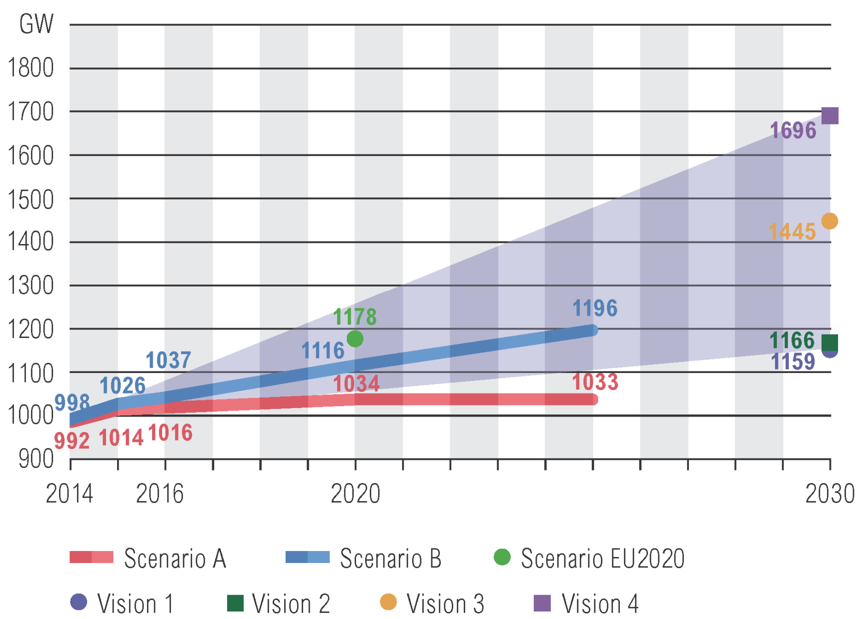

Figure 1.2: ENTSO-E total NGC development (all Scenarios; January 7 p.m.; GW)

Norway (94%) and Denmark (85%) are the countries with the highest share of RES in NGC in 2025, followed by Austria, Portugal and Switzerland. Several of these countries are dominated by hydro power plants, however examples of countries with a different generation structure can also be found. Such strong RES development is mainly influenced by the legislation within each country (as well as the outstanding potential of course), which encourages the development of RES power plants (excluding or including hydro power plants) through the implementation of policies such as feed-in tariffs and/or the implementation of regulatory provisions put forward in the EU RES directive from 2009 on conditions for RES generators for access and connection to the grid. Sub-categories of renewable generation are discussed in detail in the report, with wind and RES-hydro being the dominant ones in general.

The NGC of the fossil fuels category in Scenario B is expected to remain constant until 2015, with a steady decrease in the rest of the period (until 2025), initially as a consequence of the Large Combustion Plants Directive (LCP) and later due to a relatively low amount of planned investment under the expected market conditions. This new version of the SO&AF also takes into account the information available to TSOs regarding the future of CCGT (running capacity, decommissioning, etc.). On a longer horizon until 2030, Visions 1 and 2 forecast fossil capacity close to the 2025 amount, while Visions 3 and 4 correspond to a capacity near its present value. Gas-fired power plants have the largest share within the fossil fuels category (being the only subtype to increase capacity in absolute value). This ratio increases from 46% in 2014 to 51% in 2020, 57% in 2025 and 62 to 68% in 2030. Other fossil fuel categories show either more or less visible decreases, or remain fairly stable.

It needs to be noted though that it is not within the scope of SO&AF methodology to fully take into account market trends, in particular the long-term economic viability of fossil-fuel plants. Work on extending the SO&AF methodology in this sense is considered for the coming reports.

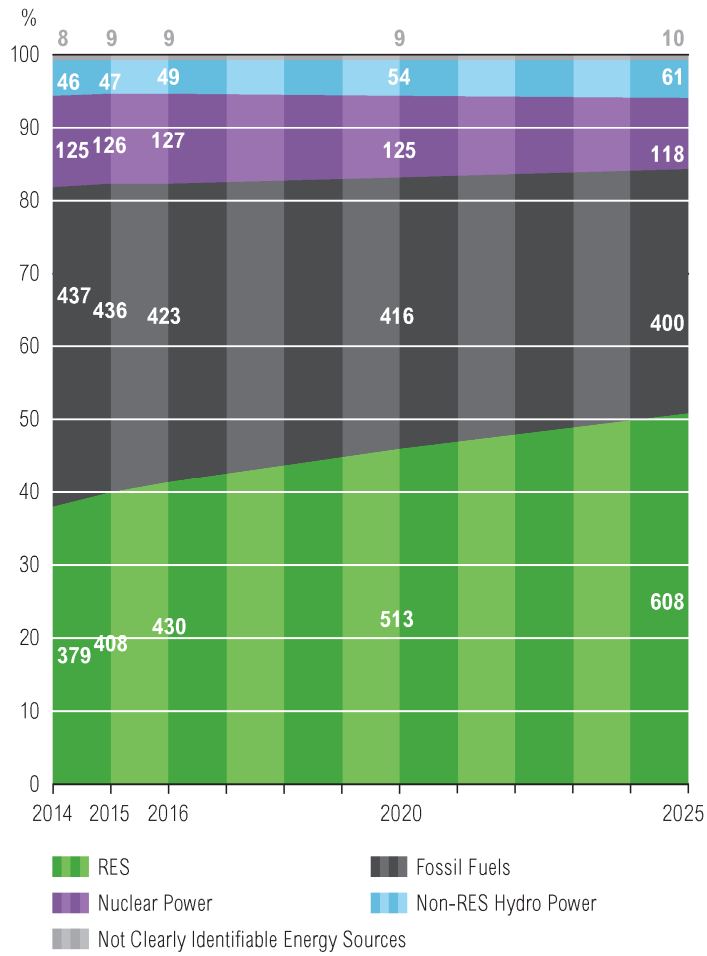

Figure 1.3: ENTSO-E total NGC breakdown per fuel type (all years; Scenario B; January 7 p.m.)

Considering the only firm capacity projects in Scenario A, the total NGC is still increasing up to 2020 (it is assumed that no investment plan can be taken as confirmed in the period 2020-2025 and thus is not taken into account in Scenario A). Again, the largest share corresponds to Fossil Fuels and RES, but the share of RES is increasing (from 38% in 2014 to 44% in 2020 and 48% in 2025), whereas the share of Fossil Fuels is decreasing (from 44% in 2014 to 39% in 2020 and 36% in 2025). Among the Fossil Fuels, the Gas power plants maintain the highest and slightly increasing share, whilst the remaining categories are either decreasing or stable.

Within the total renewable capacity mix, wind, solar and biomass power plants are expected to increase, while the share of renewable hydro power plants is expected to decrease in some of the monitored years as a consequence of a lower development pace. On-shore wind farms continue to play a major role in the wind power plants category; their share in total wind capacity remaining at least 80% in all scenarios until 2020 and about 78% in 2025. However, offshore wind generation is foreseen to become increasingly significant in the future. While in Vision 1, offshore remains at approximately 19% of total wind installed capacity, in Vision 4 this ratio develops up to 29%.

Furthermore, an important increase of solar capacity is expected for the future in consideration of the current policies adopted at EU and national level in the renewable and energy efficiency field.

1.2 Main results – system adequacy

Reliable Available Capacity (RAC = NGC ï UC, where UC means unavailable capacity and consists of non-usable capacity, maintenance & overhauls, outages and reserves). In the best estimate (Scenario B), RAC increases at both reference points over the period 2016 - 2025. The RAC in January is higher than in July, as is required to cover load and due to lower amounts of planned maintenance & overhauls.

The Remaining Capacity (RC = RAC - load) decreases slightly over the period between 2015 and 2025. Remaining Capacity is higher than the Adequacy Reference Margin (ARM) during the entire period until 2025 at both reference points, and generation adequacy is thus met in most of the situations at an ENTSO-E system level (not considering capacity limitations between countries and/or regions). The level of adequacy (characterised by the difference between the RC and the ARM) is considerably decreasing during the assessed period at both reference points.

The average share of RAC in the total ENTSO-E NGC in 2020 is expected to be about 59% in January (55% in July), further decreasing to 56% (January) and 52% (July) in 2025. The available capacity is expected to grow at a slower pace than the generation capacity, due to an increased share of intermittent energy sources in the generation mix. Unavailable capacity thus occupies an increasingly larger share of NGC. Furthermore, due to the high expected penetration of variable generation into the energy mix, complementary measures such as the ones described in the ENTSO-E network codes become even more urgently needed to ensure the balancing of the system in the most efficient manner for the consumer.

In conservative Scenario A, RAC decreases from 637 GW in 2014 to 618 GW in 2020 and 584 GW in 2025 (for January 7 p.m.). Without additional units commissioned, generation adequacy is expected to be met beyond 2016, while in 2020, the level of adequacy is becoming slightly negative and further declining towards 2025.

Additional generation units seem to be necessary in Europe to have a sufficient level of margins. In 2020, 47 GW of additional RAC (beyond already confirmed investments) is required to reach todayôs level of adequacy, while this figure exceeds 100 GW by 2025. Depending on the penetration of variable generation to the overall energy mix, this could imply that the level of required investment in terms of installed capacity is significantly higher.

Under best estimate Scenario B, adequacy levels remain in the positive range, however, with steadily decreasing margins in the beginning of the next decade.

When comparing these results to the previous Scenario Outlook and Adequacy Forecast (published in 2013), a decline in forecast adequacy levels is observed.

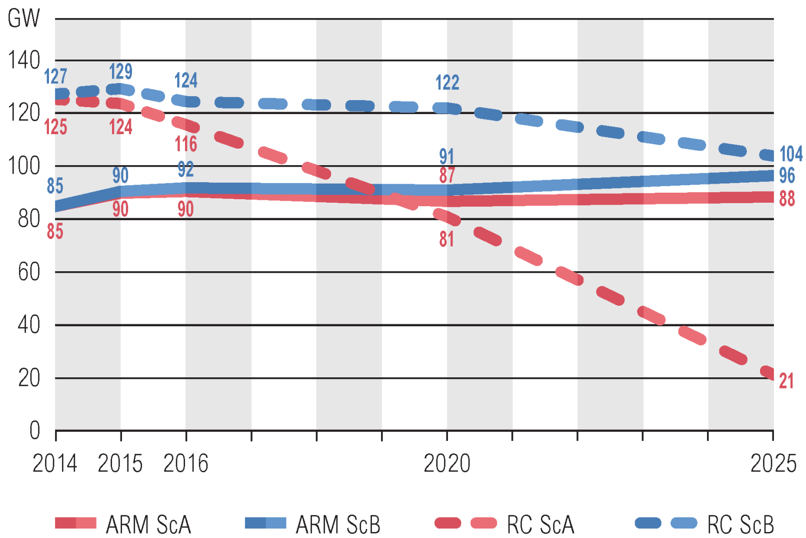

Figure 1.4.: ENTSO-E RC and ARM comparison, Scenarios A&B, January 7 p.m.

1.3 Stakeholder Consultation Process on future ENTSO-E Adequacy Assessment

The European electricity industry is experiencing significant change; the integration of large amounts of renewable energy sources, the creation of the Internal Electricity Market, new storage technologies, demand side response and evolving policies all require an improvement of the adequacy assessment methodologies. ENTSO-E will develop its existing European methodology with a special emphasis on harmonised inputs, system flexibility and interconnected assessments.

It is crucial that stakeholders are involved in the process of developing a new methodology for system adequacy from the outset. Through dialogue, our aim is to become aware of concerns, expectations and requirements of stakeholders and interested parties with regards to the new adequacy methodology.

An inaugural workshop on ENTSO-E adequacy assessment took place on Wednesday 16 April 2014 in Brussels. Next steps include the hosting of a methodology proposal workshop in June 2014, followed by a two-month online consultation resulting in the publication of a methodology and implementation plan.

Look for more details on the SO&AF consultation section in the Adequacy page on ENTSO-E website: https://www.entsoe.eu/publications/system-development-reports/adequacy-forecasts/

2. Introduction

2.1 Purpose of this Document

According to Article 8(3)b of Regulation (EC) No 714/2009 ENTSO-E publishes the Scenario Outlook & Adequacy Forecast (SO&AF), a European generation adequacy outlook, describing the data and the methodology for system adequacy analysis. The SO&AF aims at providing stakeholders in the European electricity market with a pan-European overview of generation, demand and their adequacy using different scenarios for the future ENTSO-E power system focusing on the power balance, margins, energy indicators and the generation mix.

The SO&AF is not assessing the economic aspects (e.g. feasibility) of generation assets per investigated scenario. The economic aspects are investigated and analysed within the market studies performed in the framework of the ENTSO-E Ten Year Network Development Plan (TYNDP) issued biennially, each even year. For example, in market analyses the fuel prices of different technologies as well as the greenhouse gasesô prices can also be mirrored. Thus, the SO&AF is focused on the technical aspects of the adequacy assessment without considering the economic aspects. It is also not the goal of the SO&AF to assess the role of interconnectors and impacts of the generation adequacy on the grid which is more relevant for TYNDP and Regional Investment Plans (RgIPs).

The SO&AF is based on national data as provided by each ENTSO-E member TSO or a national organization responsible for data collection for different TSOs (ñsource-dataò). The relevant RES availability data is also provided by the ENTSO-Eôs member TSOs and from other sources[1]. ENTSO-E cannot be held liable for any inaccurate or incomplete data contained or used for this analysis or for any resulting misled assessment based on such data.

2.2 Objectives and tools

The SO&AF assesses in general the mid- and long-term time horizon focusing on adequacy analyses of the ENTSO-E member TSOsô interconnected transmission system throughout an overview of generation adequacy on the basis of different scenarios.

The SO&AF 2014 report provides in Chapter 7 a description of the scenarios which are used as background assumptions for carrying out the market and network studies within the TYNDP framework. The underlying scenarios adopted for the TYNDP 2014 and used for the RgIPs contained therein are updated in order to capture the main evolution in respect to the scenarios initially presented in the SO&AF 2013.

Based on the described scenarios, the SO&AF 2014 report contains the following:

- an outlook of the generation adequacy of the areas covered by ENTSO-E member TSOs for the period 2014 ï 2030, by providing a generation adequacy analysis for these areas according to Article 8(3)b of Regulation (EC) 714/2009 (pan-European generation adequacy outlook, Chapters 3 and 4);
- description of the generation adequacy outlook for each individual country or area, based on national data received from ENTSO-E member TSOs (national generation adequacy outlooks, Chapter 6).

The above pan-European generation outlook is analysed in two main chapters of the SO&AF containing the following:

- Chapter 3 on quantitative data on the evolution of load and the generation mix based on:
  - two scenarios (scenarios A and B) covering the period until 2025;
  - one scenario based on the fulfilment of the EU 2020 energy policy targets, translated into a national level (scenario EU 2020);

[1] The Pan-European Climate Data has been provided to ENTSO-E by the Technical University of Denmark.

  - four visions aiming at identifying possible cornerstones of development until 2030. The visions of ENTSO-E towards 2030 (ñ2030 Visionsò) aim at offering a ñbridgeò between the European energy targets for 2020 and 2050. The assumptions of each ñVisionò are detailed in Chapter 7.

- Chapter 4 on the detailed adequacy analysis which was carried out over two contrasting scenarios up to 2025 and over one comparison scenario related to the EU 2020 targets as mentioned above. These cover different evolutions for generating capacity and load, using the same criteria for the assessment. The assessment is based on the comparison between the reliably available generation and load at two given reference points in time in the year (the third Wednesday in January at 7 p.m. and the third Wednesday in July at 11 a.m.) over the monitored time period under standard conditions.

The mentioned scenarios in brief are the following:

- Scenario A (or Conservative Scenario): this bottom-up scenario shows the necessary additional investments in generation beyond the ones already confirmed to maintain current levels of security of supply in the future; it takes into account the commissioning of only the new power plants which are considered as confirmed according to the information available to the TSOs; load forecast in this scenario is the best national estimate available to the TSOs, under normal climatic conditions;

- Scenario B (or Best Estimate Scenario): this bottom-up scenario gives an estimation of potential future developments, provided that market signals give adequate incentives for investments; it 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; load forecast is treated the same as in Scenario A above.

- Scenario EU 2020: this top-down scenario gives an estimation of potential future developments, under the assumption that governmental targets set for renewable generating capacities in 2020 are met; it derives from the EU policies on climate change and is based on national targets set in the National Renewable Energy Action Plan (thereinafter only ñNREAPò) or equivalent governmental plans for renewable energy development mainly if no NREAP applies; the scenario does not exclude any further possible renewable energy generation development on the national level.

Even though the scenarios are based on a different approach (top-down vs. bottom-up), for their assessment the same criteria and methodology (see about the SO&AF methodology Chapter 7) are used. The data sources are however, different in the various scenarios. Scenarios A & B are based on the information and own estimations from respective TSOs, whereas Scenario EU 2020 is based on the NREAP or other official governmental plans.

The aim of the scenarios is not to recommend any direction of grid development, as this is the scope of the TYNDP, which is published biennially. However, there is a strong interplay between the chosen scenarios and the results in the TYNDP in terms of grid development. Deeper description of the scenarios and the methodology used for the adequacy assessment can be found in Chapter 7.

In the current SO&AF 2014, the generation adequacy is assessed through the separate parameters Reliable Available Capacity (RAC), Remaining Capacity (RC) and Adequacy Reference Margin (ARM). The above-mentioned approach is a power balance-based assessment, and it is intended to be integrated by the development of an energy approach assessment in the future using the market analyses in the SO&AF report.

Regarding RES integration, ENTSO-E uses the most comprehensive pan-European climate data (e.g. for wind, solar, temperatures). RES integration data, including the RES availability, is provided by the TSOs based upon their experience for the pan-European and national analyses. For the regional analysis in Chapter 4.2 the same RES data is taken into account, apart from the data on the availability of wind and solar generation corresponding to 90% probability in each country, which is based on detailed pan-European climate data provided to ENTSO-E by the Technical University of Denmark.

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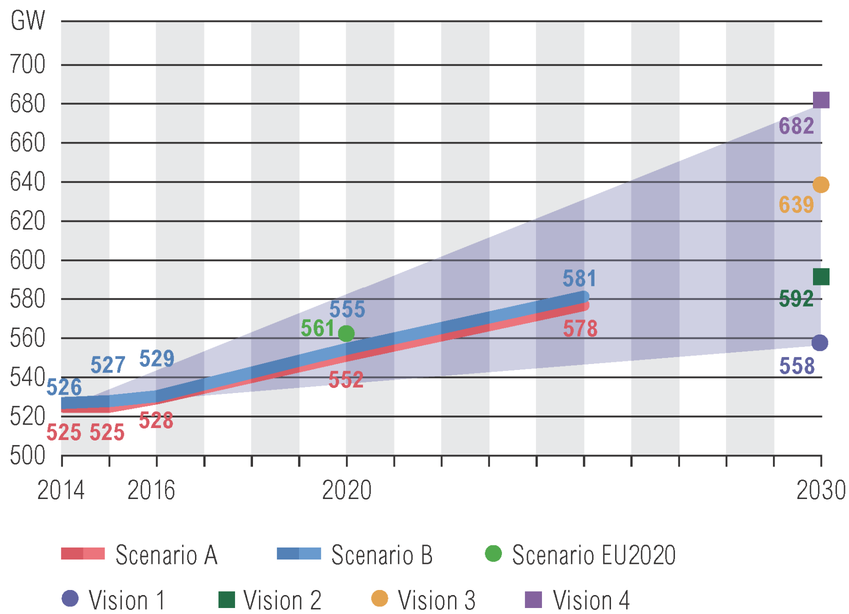
3. Scenario Outlook

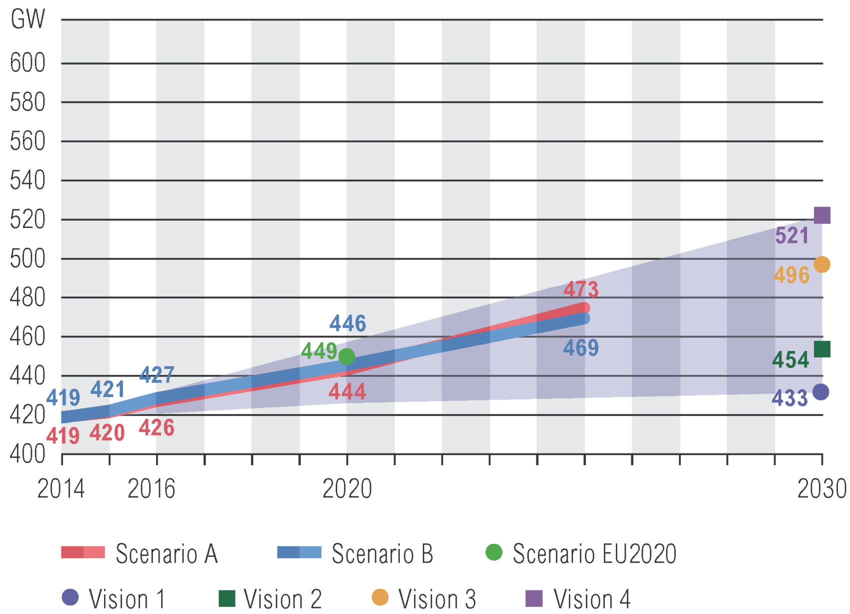
3.1 Load forecast

Load evolution

The ENTSO-E load at reference point in January in the two bottom-up Scenarios A and B is expected to increase by 55 GW between 2014 and 2025, reaching 581 GW, as shown in Figure 3.1.1. This corresponds to a compound annual growth of 0.91 %. The similar increase can be observed in July, going from 419 GW in 2014 up to 469 GW in 2025.



F. 3.1.1. - ENTSO-E load forecast for all scenarios in January [GW]

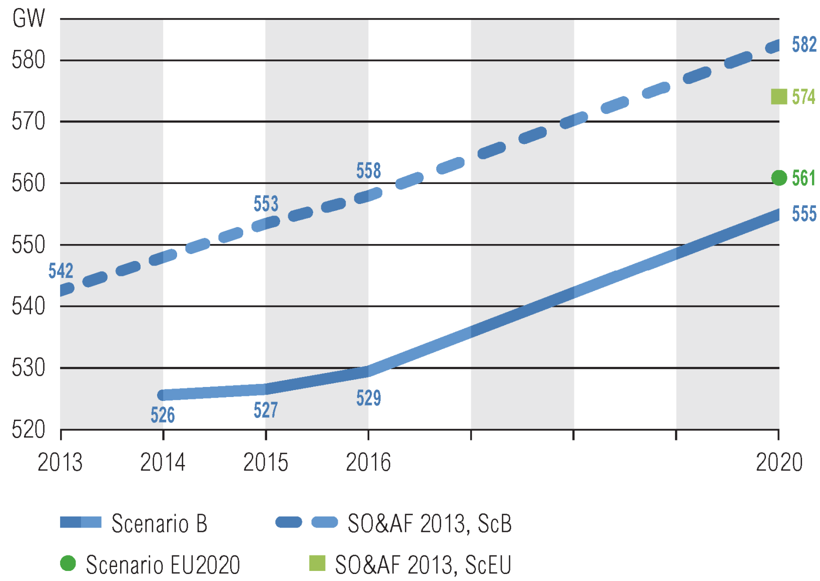


F. 3.1.2. - ENTSO-E load forecast for all scenarios in July [GW]

Load estimate of the top-down Scenario EU 2020 is with 561 GW in January and 449 GW in July slightly higher than in Scenario A and B.

Long-run visions Vision 1 to 4 estimate load in 2030. It is assumed that the lowest load is estimated in the Vision 1 (January 558 GW, July 433 GW), followed by Vision 2 (January 592 GW, July 454 GW) and Vision 3 (January 639 GW, July 496 GW).The highest load is estimated in the Vision 4 (January 682 GW, July 521 GW).

As shown in Figure 3.1.3, the rate of load growth of the updated Scenario B and EU 2020 in January is lower than in previous SO&AF 2013ï 2030, both due to lower initial values and slower forecast growth in the next few years.



F. 3.1.3 – Differences between ENTSO-E load forecast in SO&AF 2013-2030 and in SO&AF 2014-2030 for scenario B and EU2020 in January [GW]

Scenario A and B

ENTSO-E load trends of Scenario B are presented in Table 3.1.1. In January, annual growth rate is expected to increase from 0.36 % till the year 2016 to 1.18 % between 2016 and 2020 and 0.91 % between 2020 and 2025. The winter reference values correspond to the annual peak load in the majority of countries as well as on a compound level, however, several summer-peaking countries exist within the ENTSO-E system. The values in July show a more steady growth, with an initial annual rate of 0.93 % to evolve to 1.09 % between 2016 and 2020 and 1.02 % between 2020 and 2025.

	2014-2016		2016-2020		2020-2025		2014-2025	
	[%, yearly]	[GW]	[%, yearly]	[GW]	[%, yearly]	[GW]	[%, yearly]	[GW]
January 7 p.m.	0.36%	3.84	1.18%	25.51	0.91%	25.78	0.91%	55.13
July 11 a.m.	0.93%	7.81	1.09%	18.87	1.00%	22.70	1.02%	49.38

T. 3.1.1 - ENTSO-E load increase for Scenario B

	Scenario B to previous SO&AF scenario B	
	[%]	[GW]
January 7 p.m.	-4.73%	-27.55
July 11 a.m.	-2.24%	-10.20

T. 3.1.2 - Differences of ENTSO-E load in scenario B with relation to scenario B of SO&AF 2013-2030, year 2020

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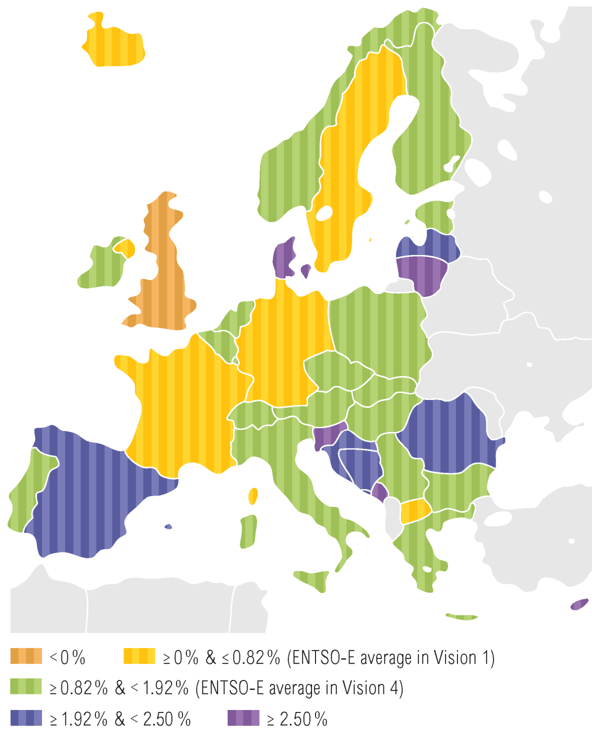

F 3.1.4 - ENTSO-E average annual load growth per country between 2014 and 2025, Scenario B, January

Looking at the load growth of individual countries between 2014 and 2025, expected in scenario B in January, GB is the only one showing a minor decrease (-0.41 %). The highest annual increase is expected in Montenegro (+5.49 %), followed by Slovenia (+3.22 %), Cyprus (+2.93 %), Denmark (+2.57 %), Lithuania (+2.52 %), Spain (+2.14 %), Bosnia and Herzegovina (+2.12 %), Romania (+2.01 %) and Latvia (+2.01 %).

The revision of Scenario B has led to decreasing load estimates by 4.74 % in January 2020, when compared to previous SO&AF. For July the decrease is slightly lower (-4.08 %).

Scenario EU2020

The load forecast for Scenario EU 2020 is expected to be based on the ñAdditional energy efficiency scenarioò of the NREAPs. It takes into account national plans for a complete mix of energy consumed in the national economy in order to meet national target value. This is in accordance with the goals of renewable energy source utilisation in total energy consumption, as defined in the third energy legislation package of the European Union.

NREAPs, however, are not available for each ENTSO-E country, since not every ENTSO-E country is an EU member. Furthermore, the first edition of the NREAPs was established in the 2000s, meaning that not all EU countries provided an update. For ENTSO-E countries not belonging to the EU and without an NREAP, the latest official document describing the long-term vision of the country or the TSOôs best estimate was used.

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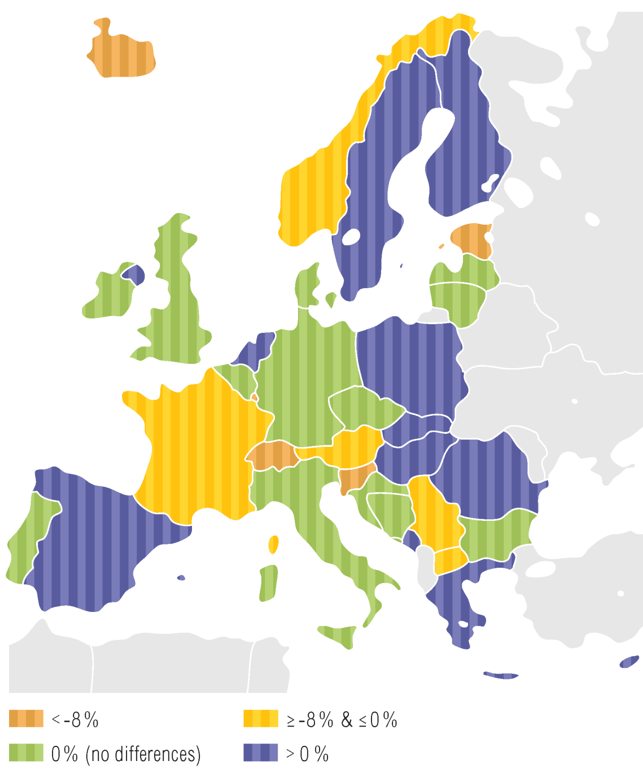
	Scenario Eu2020 to scenario B		Scenario EU2020 to scenario EU2020 in SO&AF 2013-2030	
	[%]	[GW]	[%]	[GW]
January 7 p.m.	1.08	6.01	-2.32	-13.32
July 11 a.m.	0.64	2.84	1.12	4.99

T. 3.1.3 - Differences of ENTSO-E load in scenario EU2020 with relation to scenario B and scenario EU2020 of SO&AF 2013-2030, year 2020

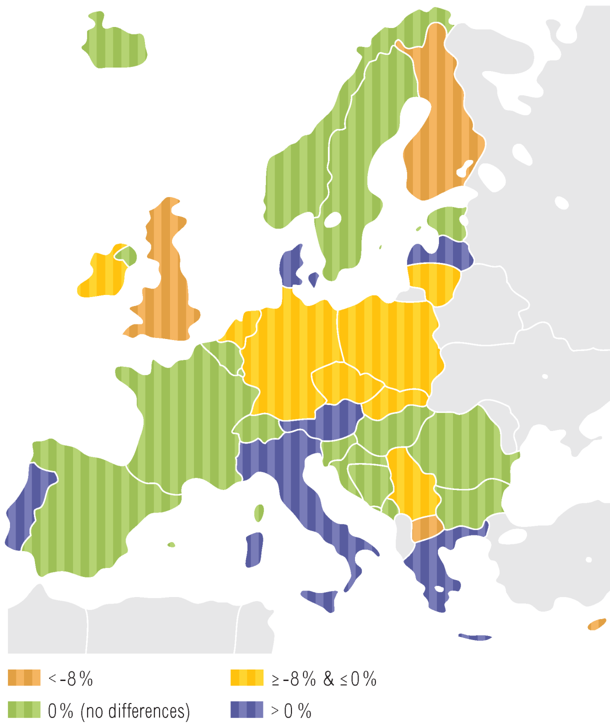
As seen in Table 3.1.3, when compared to the Scenario B and the previous SO&AF, the forecast ENTSO-E load of the new Scenario EU 2020 is higher than in Scenario B.

Higher loads in Scenario EU 2020 compared to Scenario B probably mean that national NREAPs are not up to date since the consumption decreased due to the impact of global financial crisis. For year 2020, the load in Scenario EU 2020 is 1.08 % higher than in Scenario B at the January reference point and 0.64 % higher for the July reference point. When comparing the load estimated for EU2020 scenario to that in the SO&AF 2013 report, the assumed load was revised but in different sense for the two reference points, decreasing the expected difference between summer and winter peak loads.



F 3.1.5 - Difference of ENTSO-E load in 2020 in Scenario EU 2020 with relation to Scenario B, January

Differences in load (at reference point January) between Scenario EU 2020 and Scenario B are shown in Figure 3.1.5. Luxemburg presents the lowest EU 2020 load compared to Scenario B (-14.29 %), followed by Slovenia (-13.73 %) and Iceland (-9.09 %). At the other end we find Romania (+17.25 %), Greece (+16.86 %), Hungary (+16.39 %), Cyprus (+15.15 %) and Spain (+13.72 %).



F 3.1.6 - Difference of ENTSO-E load in 2020 in Scenario EU 2020 with relation to Scenario EU 2020 SO&AF 2013-2030, January

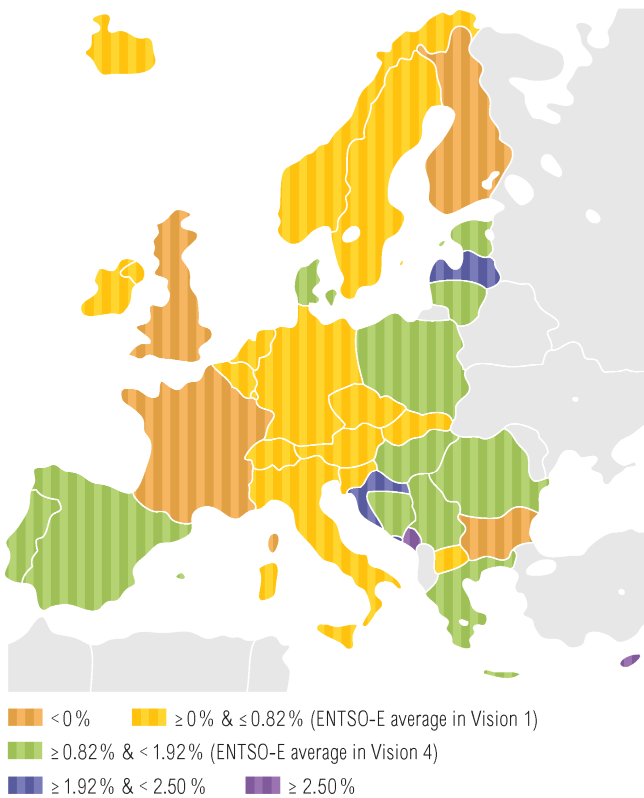
Concerning the revision of Scenario EU 2020 (Figure 3.1.6), half of countries did not change the EU 2020 load data, 6 of them (Denmark, Latvia, Greece, Austria, Italy, Portugal) increase their EU 2020 load target in January and 12 countries (Cyprus, Great Britain, FYR of Macedonia, Finland, Poland, Czech Republic, Serbia, Slovakia, Germany, Ireland, Lithuania, Netherlands) decreased the load in scenario EU 2020. The highest increase can be observed in Denmark (+12.19 %), Latvia (+9.52 %), Greece (+9.19 %) and Austria (+6.42 %), the highest decrease can be observed in Cyprus (-17.99 %), Great Britain (-15.11 %), FYR of Macedonia (-10.37 %), Finland (-9.23 %), Poland (-6.82 %), Czech Republic (-6.27 %) and Serbia (-6.04 %).

2030 Visions

The lowest load progress in the long-term perspective represents Vision 1, and the highest Vision 4. The average annual growth rate of ENTSO-E load in Vision 1 is 0.37 % (January 7 p.m.) and 0.20 % (July 11 a.m.). Four countries report negative growth for January reference point. These are Bulgaria (-0.96 %), Finland (-0.68 %), Great Britain (-0.67 %) and France (-0.16 %). While majority of countries report annual growth below 1 %, there are twelve countries with growth rate above 1 %, of which the top five are Montenegro (+3.74 %), Cyprus (+2.69 %), Latvia (+2.02 %), Croatia (1.97 %) and Greece (+1.89 %).

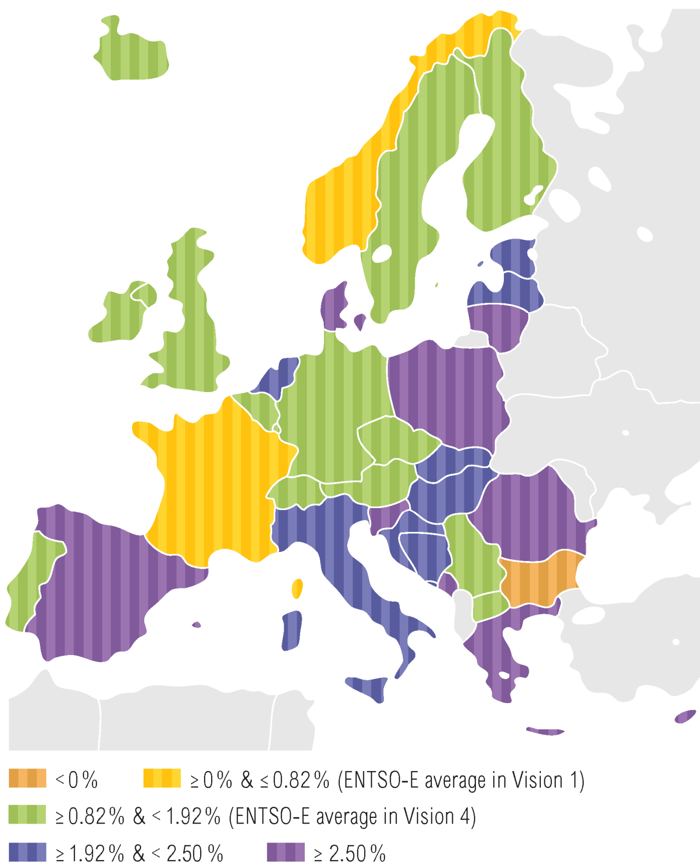
	Vision 1, 2014-2030		Vision 4, 2014-2030	
	[%, yearly]	[GW]	[%, yearly]	[GW]
January 7 p.m.	0.37%	32.27	1.64%	156.51
July 11 a.m.	0.20%	13.32	1.53%	101.68

T. 3.1.4 - ENTSO-E load increase for Vision 1 and Vision 4



F 3.1.7 - Average annual load growth per country between 2014 and 2030, Scenario Vision 1

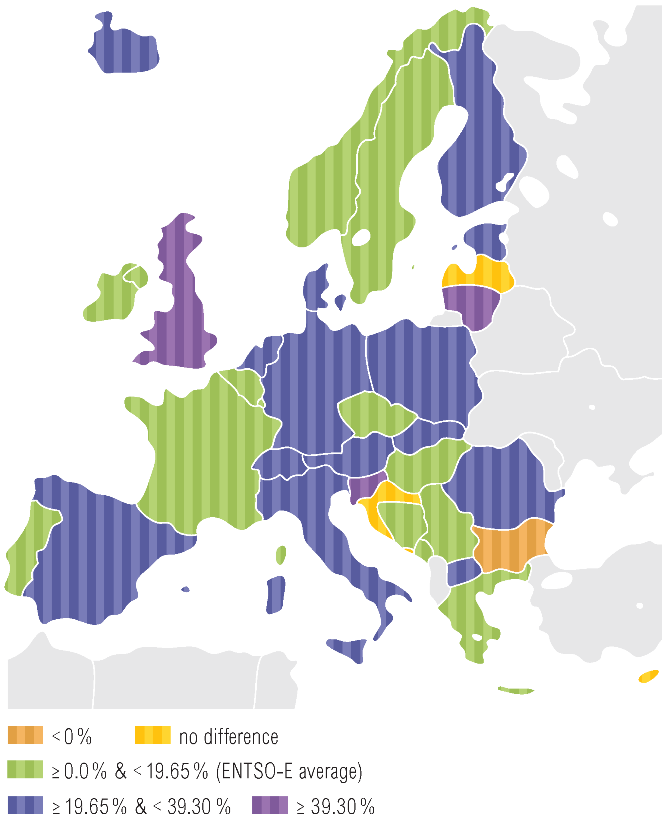
As already mentioned, the annual growth rate in Vision 4 is higher. For the whole ENTSO-E system the growth rate equals 1.64 % (January 7 p.m.) and +1.53 % (July 11 a.m.). For January reference point, with a value of -1.15 % only Bulgaria reports negative annual load growth for Vision 4. Low growth rates below 1 % are observed in France (+0.21 %), Norway (+0.47 %), Finland (+0.82 %), Sweden (+0.90 %) and Luxemburg (+0.93 %). The top five annual growing rates are in Montenegro (+4.23 %), Romania (+3.81 %), Spain (+3.56 %), Lithuania (+3.32 %) and Denmark (+3.14 %).



F 3.1.8 - Average annual load growth per country between 2014 and 2030, Scenario Vision 4

	Vision 3 to Vision 1	
	[%]	**[GW]**
January 7 p.m.	22.27%	124.24
July 11 a.m.	20.42%	88.36

T. 3.1.5 - Differences of ENTSO-E load in Vision 4 with relation to Vision 1



F 3.1.9 - Difference of ENTSO-E load in 2030 in Vision 4 with relation to Scenario Vision 1

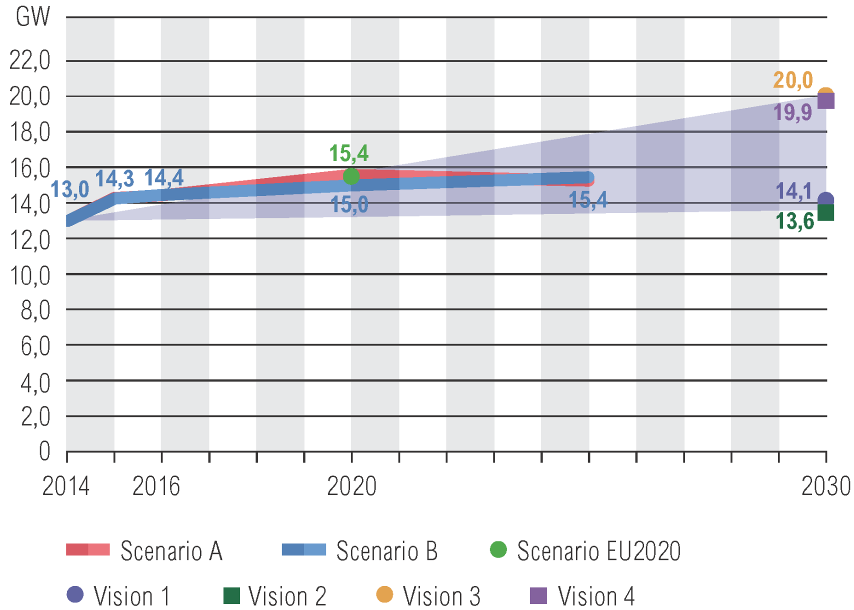
Compared to Vision 1, the ENTSO-E load in Vision 4 is higher by 22.27 % (January) and 20.42 % (July). The highest difference for January reference point is reported for Lithuania (+47.57 %), Slovenia (+42.27 %), Great Britain (+40.40%), Romania (+38.09 %) and Netherlands (+37.11 %). The lowest difference is reported for Norway (4.46 %), Serbia (4.71 %), France (6.21 %), Montenegro (7.78 %) and Ireland (9.77 %), while Cyprus, Croatia and Latvia report no differences for loads in Vision 1 and Vision 4. Bulgaria is the only one with lower load in Vision 4 than in Vision 1 (-2.96 %).

Load management

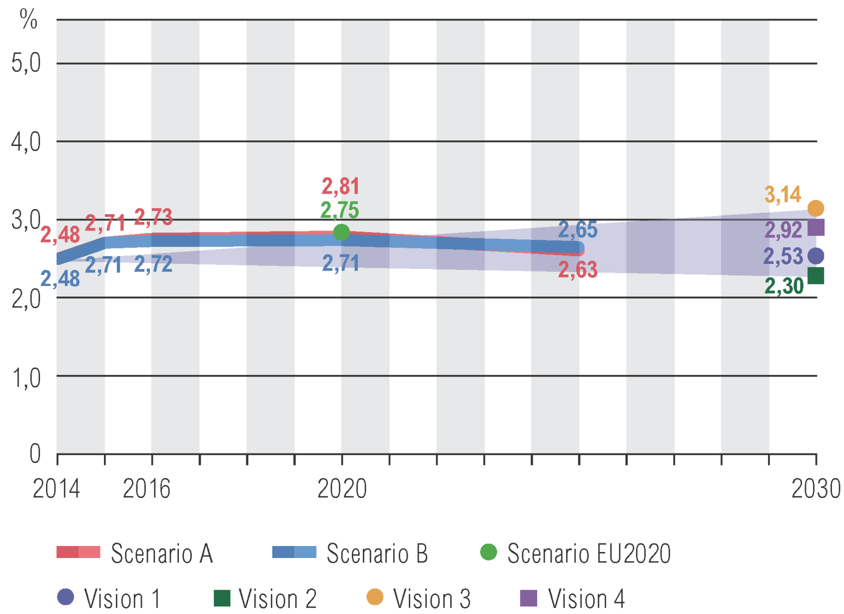
The values of load management are analysed for January reference point and the values increase in all scenarios which indicates F. 3.1.10. In the year 2025, Scenario A and B show 14.7 GW and 14.9 GW of available load management in the ENTSO-E system and in the year 2020 the scenario EU 2020 indicates 14.9 GW of load management. The values for long term visions vary according to the different assumptions, and amount to 14.1 GW in Vision 1, in Vision 2 13.6 GW, in Vision 3 20.1 GW and in Vision 4 19.9 GW. The F. 3.1.5 shows load management as percentage of the load. It can be seen that the share of available load management is not expected to increase significantly in the assessed period.

For the Scenarios A and B, only 15 countries reported values for load management higher than zero. In the Scenario B the highest load management capacity is reported for Italy (4 GW), France (3 GW) and Spain

(2.5 GW). The sum of these three countries represents 62 % of all load management in the ENTSO-E system.



F. 3.1.10 - ENTSO-E load management trends for all scenarios in January [GW]



F. 3.1.11 - ENTSO-E load management trends for all scenarios in January [%]

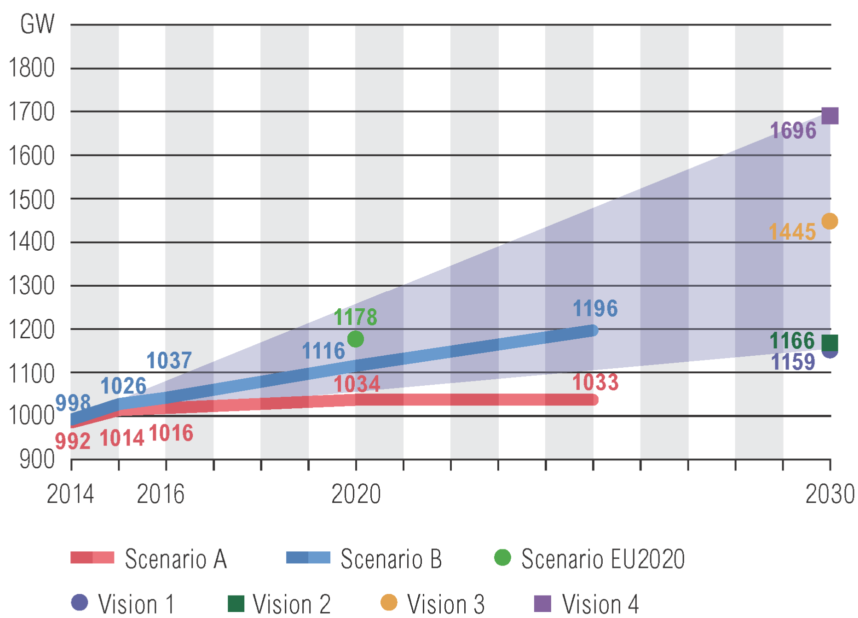
3.2 Net Generating Capacity (NGC)

Total NGC and the generation mix

This chapter contains the main description and assessment for each generation category across all Scenarios. More details are available within each subparagraph, where particular kinds of fuel and Scenarios are dealt with.

Review of all Scenarios

The evolution of total NGC for the entire ENTSO-E is shown in Figure 3.2.1.1.



F. 3.2.1.1 - ENTSO-E total NGC forecast; all scenarios; January 7 p.m. [GW]

Similarly to the load forecast, ENTSO-E total generation capacity in Scenario EU 2020 (1 178 GW) is higher than in Scenario B (1 116 GW). The foreseen evolution of confirmed generation projects (only) assumed in Conservative Scenario A results in a slight increase of capacity (+ 4.1%) between 2014 and 2025, from 992 GW to 1 033 GW, 13.6% below the best estimate of Scenario B.

Regarding 2030 Visions, general guidelines required the fulfilment of national generation adequacy criteria under normal conditions. It also should be noted that some adjustments of capacity in Vision 1 and Vision 3 were performed compared to previous SO&AF report. Updates of Scenario A resulted in Vision 1 no longer being aligned with Conservative Scenario in 2020 and 2025. Current trajectory of Scenario B seems to be pointed to somewhere between ñSlow Progressò of Vision 1 and ñGreen Transitionò of Vision 3 in 2030.

Compared to EU 2020, generation in Vision 1 (1 159 GW) is lower by 1.6%, while correspondent peak load for the third Wednesday of January is 0.5% below. On the other hand, Vision 3 (1 445 GW) looks like an extension of EU 2020 projected to 2030.

Vision 2 (1 166 GW) is very similar to Vision 1 in terms of total installed capacity, while Vision 4 (1 696 GW) forecasts an additional 17.4% of installed capacity compared to Vision 3.

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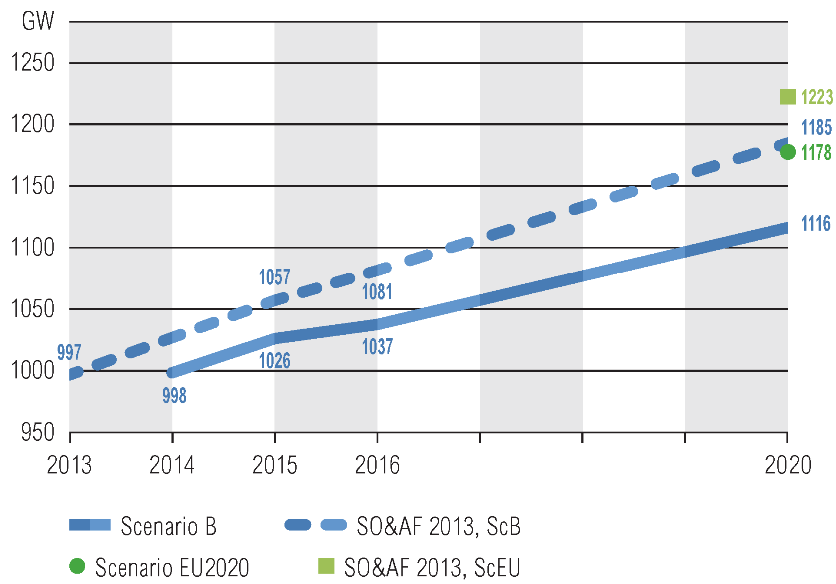
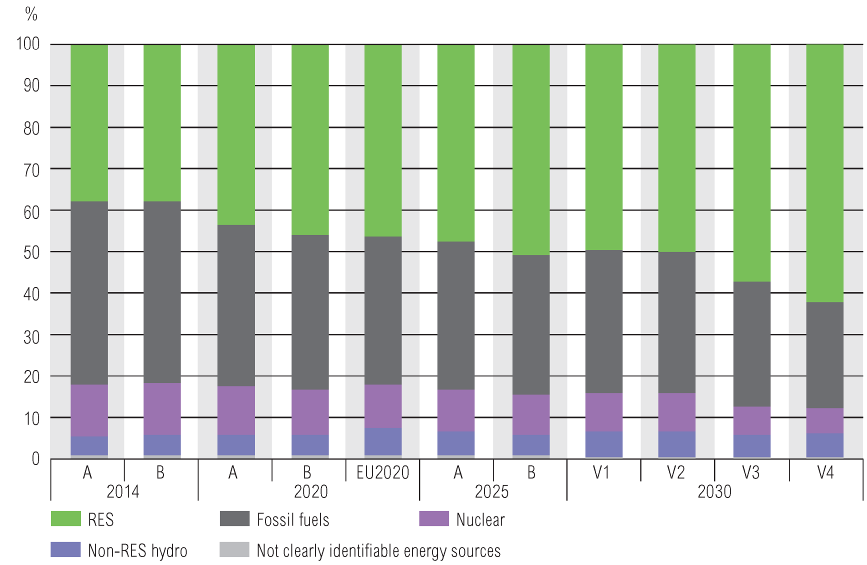
The differences between updated generation forecasts (for the January reference point) and the reported values in the previous SO&AF are shown in Figure 3.2.1.2. Generally speaking, deviations are negative, ranging between -3% and -6%. In 2020, new Scenario EU 2020 shows a decrease of 46 GW, while Scenario B decreased by 69 GW.



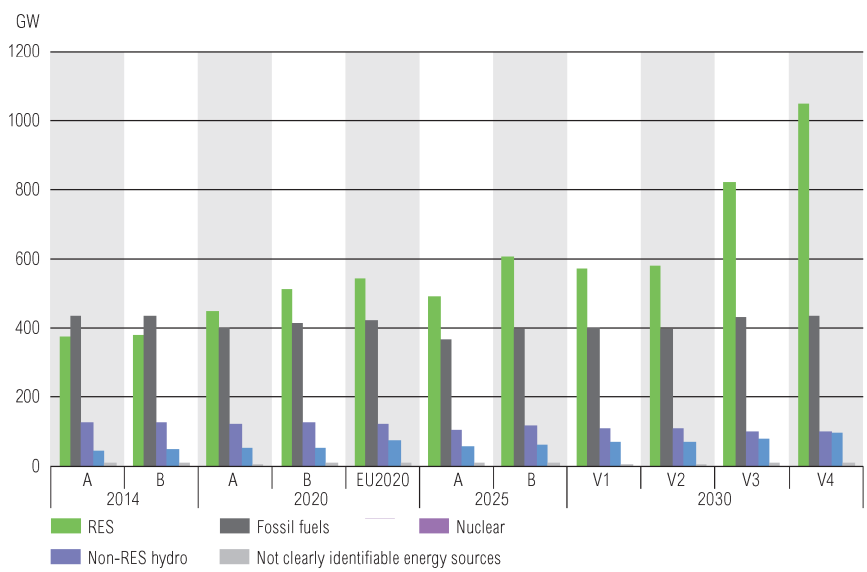
F. 3.2.1.2 – Comparison of NGC between SO&AF 2013 and SO&AF 2014; scenarios B and EU2020; January 7 p.m. [GW]

The trend of installed generation mix generally shows a decreasing share of fossil fuels over RES, as seen in Figure 3.2.1.3. During the period 2014 ï 2025 this is evidenced by bottom-up Scenarios, with fossil fuels average decrease of 9 p.p. and RES increase of 12 p.p. In EU 2020, expected installed RES share is 47%. In 2030, this value is expected to rise up to 50% in Visions 1 and 2, and higher to 58% in Vision 3 and 62% in Vision 4.

Decommissioning of nuclear power plants results in share reductions from current 13% (in 2014) to 11% in EU 2020 and further to percentages between 6% (in Vision 4) and 9% (in Vision1/Vision2).



F. 3.2.1.3 - ENTSO-E total NGC breakdown in 2014, 2020 and 2030; all scenarios; January 7 p.m.



F. 3.2.1.4 - ENTSO-E total NGC breakdown in 2014, 2020 and 2030; all scenarios; January 7 p.m.

Scenarios A, B

Variation of capacity in absolute values and average growth rates are respectively shown in Tables 3.2.1.1 and 3.2.1.2 for Scenarios A and B. As expected, the conservative forecast generally shows lower growth rates which progressively decrease along the analysed period. Nevertheless new capacity still compensates the decommissioning of old power plants until 2025. TSOôs best estimates average annual growth rate is 1.66%.

	Scenario A				Scenario B			
[GW, total]	**2014-2016**	**2016-2020**	**2020-2025**	**2014-2025**	**2014-2016**	**2016-2020**	**2020-2025**	**2014-2025**
January 7 p.m.	24	18	0	41	39	79	80	198
July 11 a.m.	19	17	-1	35	35	78	79	193

T. 3.2.1.1 – ENTSO-E absolute evolution of total NGC for Scenarios A and B

	Scenario A				Scenario B			
[%, yearly]	**2014-2016**	**2016-2020**	**2020-2025**	**2014-2025**	**2014-2016**	**2016-2020**	**2020-2025**	**2014-2025**
January 7 p.m.	1.20%	0.43%	-0.01%	0.37%	1.94%	1.85%	1.39%	1.66%
July 11 a.m.	0.95%	0.41%	-0.01%	0.32%	1.75%	1.83%	1.37%	1.61%

T. 3.2.1.2 – ENTSO-E yearly evolution of total NGC for Scenarios A and B

Looking at subcategories in Table 3.2.1.3, contributions to building capacity generally come from RES and non-RES hydro with the first increasing annually between 2.49% and 4.4%, whilst the latter increases between 2.03% and 2.19%. Compared to Scenario A, in Scenario B, RES installed capacity increases further 112 GW until 2025. Fossil fuels present a general decrease between 37-70 GW. With regards to nuclear power plants, the common trend is also a decreasing capacity until 2025 by a total amount of 18 GW (loss rate of 1.41% annually).

	Scenario	**2014-2025**	**Fossil fuels**	**RES**	**Non-RES hydro**	**Nuclear**
January 7 p.m.	**A**	**[GW, total]**	-70	117	12	-18
		[%, yearly]	-1.57%	2.49%	2.19%	-1.41%
	B	**[GW, total]**	-37	229	12	-8
		[%, yearly]	-0.80%	4.40%	2.03%	-0.59%
July 11 a.m.	**A**	**[GW, total]**	-70	113	12	-19
		[%, yearly]	-1.58%	2.38%	2.12%	-1.51%
	B	**[GW, total]**	-36	225	12	-9
		[%, yearly]	-0.79%	4.27%	1.94%	-0.67%

T. 3.2.1.3 – ENTSO-E NGC subcategories evolution for Scenarios A and B

The evolution of generation in Scenario B (in January) is shown in Figure 3.2.1.5, where RES capacity presents noticeable variation in absolute terms, reaching 608GW, replacing part of fossil fuels and nuclear. Consequently, RES share in generation mix increases by around 13 percentage points. The slight increase of non-RES hydro capacity enables this subcategory to maintain its share (around 5%).

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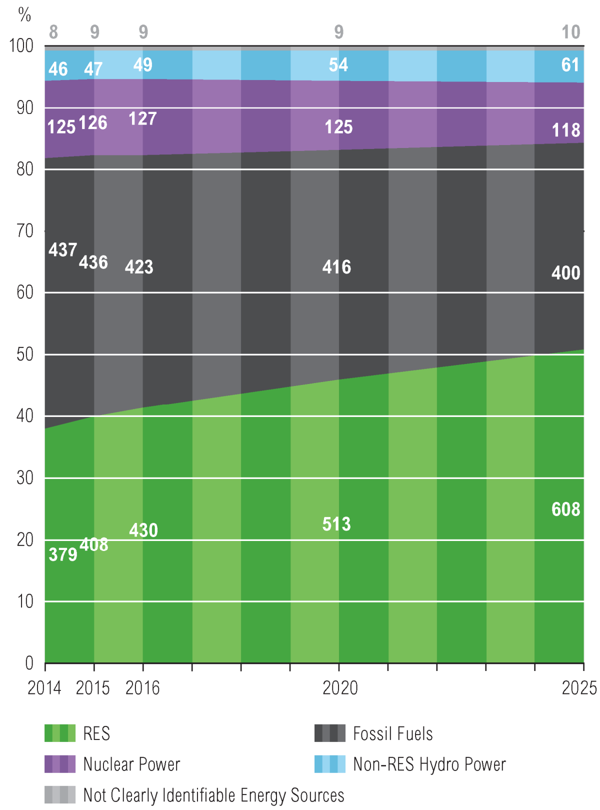


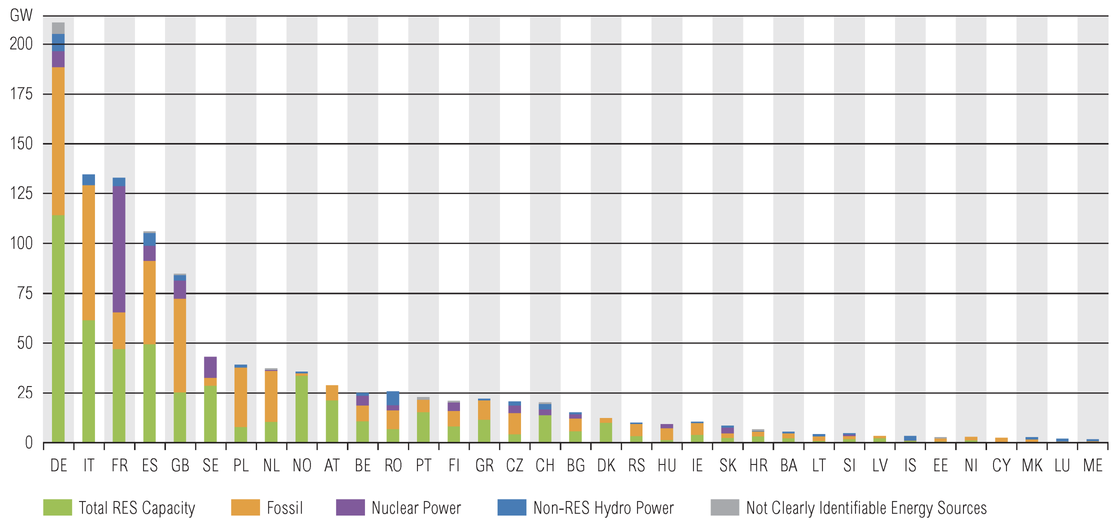
F. 3.2.1.5 – ENTSO-E total NGC mix; Scenario B; January 7 p.m. [GW]

Individual country generation mix in Scenario B (in January 2020) is depicted in Figure 3.2.1.6 (without correction regarding the size of the country) and Figure 3.2.1.8 (relative values).

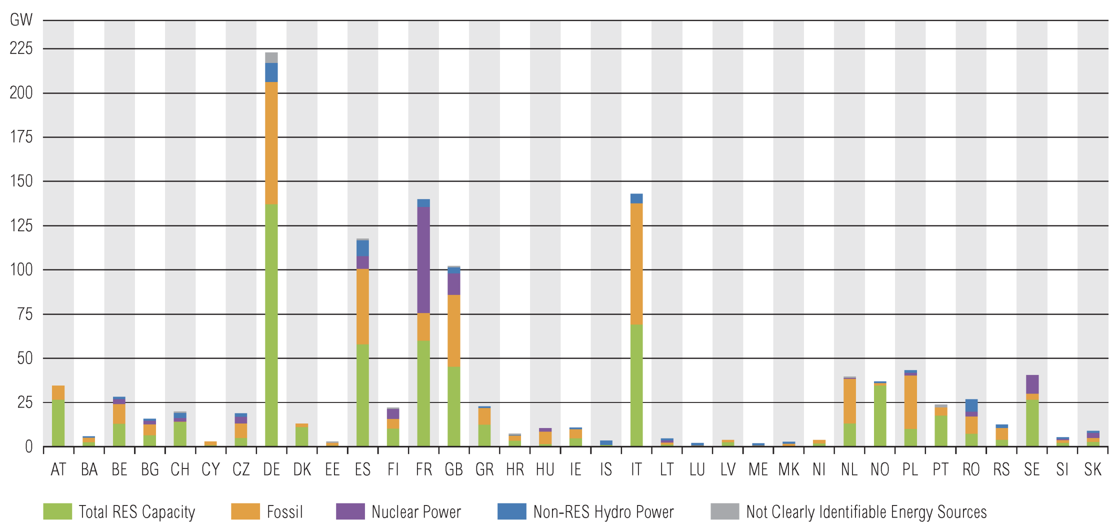
Forecasts of aggregated RES capacity in Germany (114.3 GW), Italy (61.7 GW), Spain (49.5 GW) and France (47.1 GW) sum-up approximately 273 GW, which amounts to more than half of the entire RES capacity installed in the ENTSO-E system. Looking at 2025 (3.2.1.7. and 3.2.1.9.), the same applies, where these 4 countries account for more than 53% of total forecasted RES capacity.

Best estimates of RES share for 2025 put Norway in leading position with 94%, followed by Denmark (85%), Austria (77 %), Portugal (74%), Switzerland (72%), Latvia (70%) and Sweden (66%).

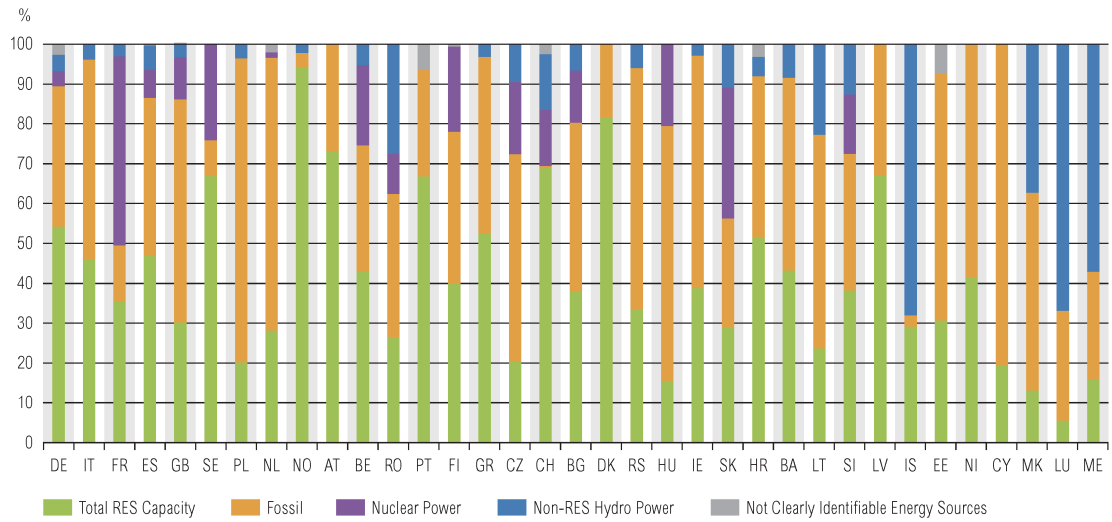
Nevertheless, some countries remain to strongly rely on fossil fuels, such as Cyprus (73%), Poland (70%), Hungary (66%), the Netherlands (64 %) and Estonia (60%). In 2025, France will maintain 60 GW of its nuclear capacity, representing the highest absolute value and share (43 %) among ENTSO-E countries.



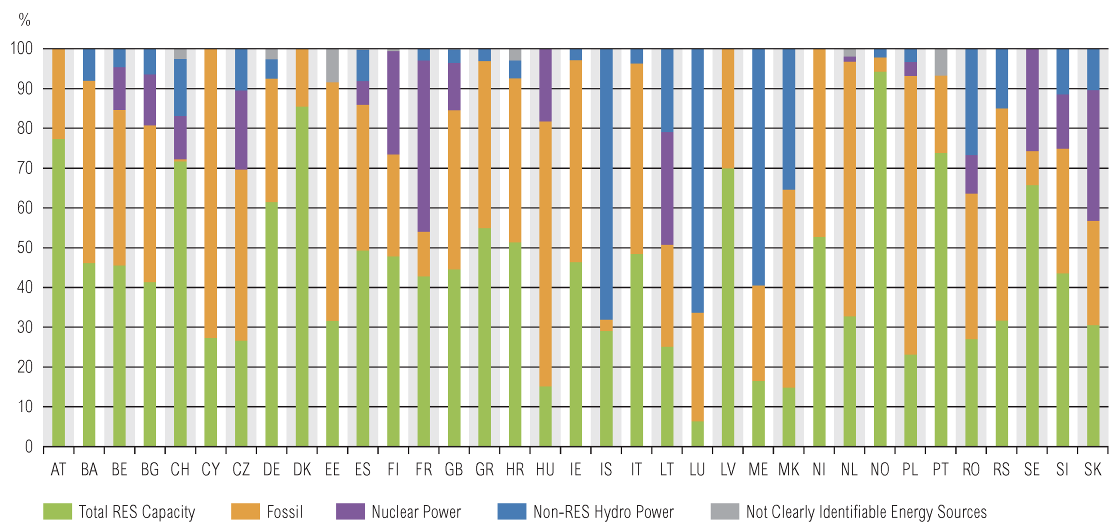
F. 3.2.1.6 – Total NGC breakdown per country in 2020; Scenario B; January 7 p.m.



F. 3.2.1.7 – Total NGC breakdown per country in 2025; Scenario B; January 7 p.m.



F. 3.2.1.8 – Total generation capacity mix per country in 2020; Scenario B; January 7 p.m.



F. 3.2.1.9 – Total generation capacity mix per country in 2025; Scenario B; January 7 p.m.

Scenario EU2020

The differences in NGC between Scenario EU 2020 and its previous version, as well as in comparison to Scenario B, are shown in Table 3.2.1.4 and Table 3.2.1.5. Revised Scenario EU 2020 presents a decrease in NGC between 3.7% and 4.4% (depending on the season) compared to the previous one published in

SO&AF 2013. The opposite is observed with relation to Scenario B, where increases reach nearly 5.5%, mostly because of RES (around 6.5%) and non-RES hydro (around 42%).

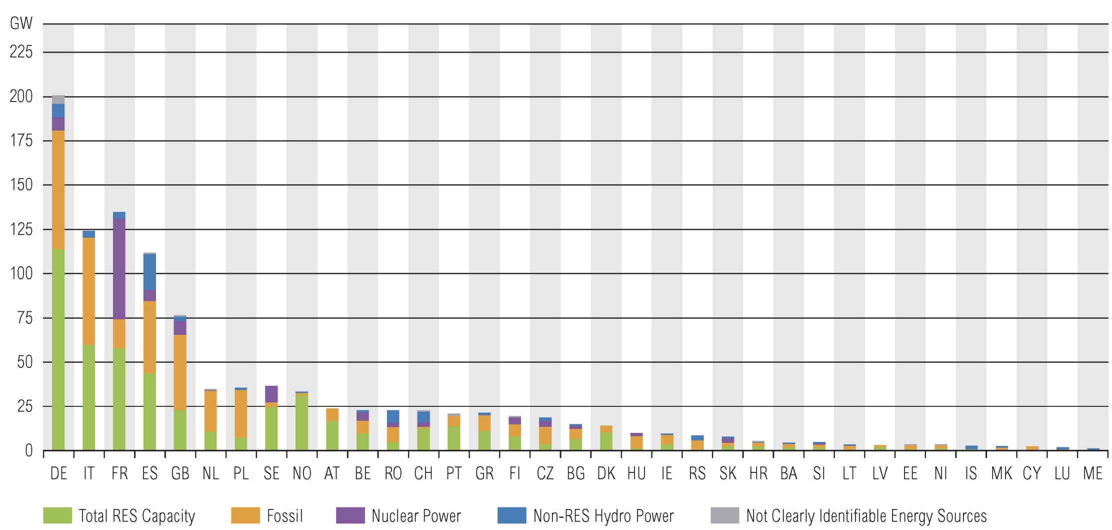
	Scenario Eu2020 to scenario B		Scenario EU2020 to scenario EU2020 in SO&AF 2013-2030	
	[%]	[GW]	[%]	[GW]
January 7 p.m.	5.49%	61	-3.72%	-46
July 11 a.m.	5.57%	62	-4.39%	-54

T. 3.2.1.4 - Differences of ENTSO-E NGC in scenario EU2020 with relation to scenario B and scenario EU2020 of SO&AF 2013-2030

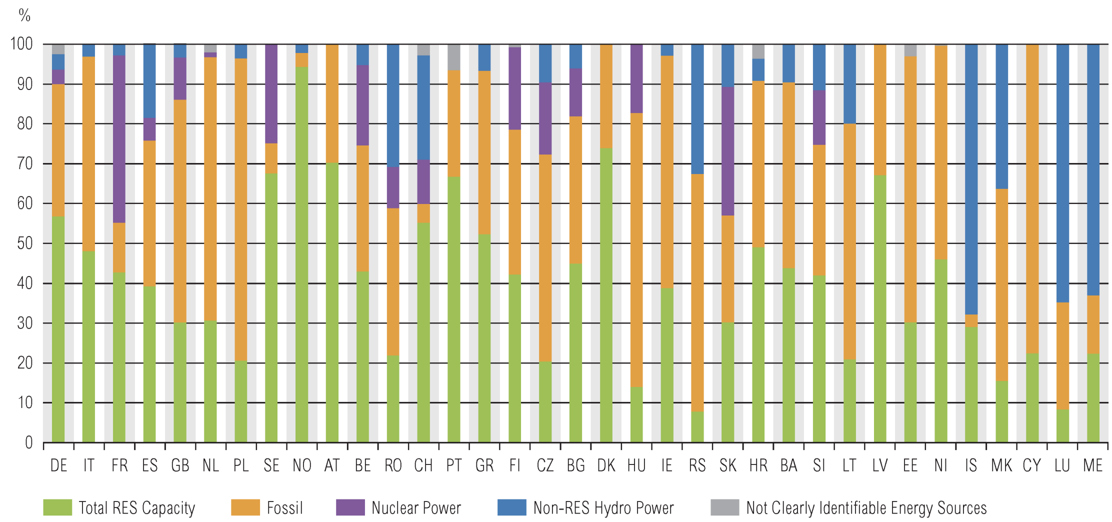
	Scenario Eu2020 to scenario B	Fossil fuels	RES	Non-RES hydro	Nuclear
January 7 p.m.	[GW]	6	33	23	-1
	[%]	1.51%	6.51%	41.99%	-0.71%
July 11 a.m.	[GW]	6	34	23	-1
	[%]	1.48%	6.65%	42.69%	-0.71%

T. 3.2.1.5 – Differences of ENTSO-E NGC subcategories in scenario EU2020 with relation to scenario B

Estonia presents the highest difference of NGC (+44%) when comparing Scenario EU 2020 and Scenario B. On the other side, in 2020, Montenegroôs top-down Scenario is forecasting the lowest generation capacity in comparison to Scenario B (-16%). With regards to RES, 46% of ENTSO-E countries foresee higher shares of this subcategory against Scenario B, led by Luxemburg (+51%).



F. 3.2.1.10 – Total NGC breakdown per country in 2020; Scenario EU 2020; January 7 p.m.



F. 3.2.1.11 – Total generation capacity mix per country in 2020; Scenario EU 2020; January 7 p.m.

2030 Visions

The evolution of NGC as forecast in long-term Visions is depicted in Table 3.2.1.6. Compared to Scenario B in 2013, the NGC in Vision 1 is to increase by 161 GW (in January), representing an average annual growth rate of approximately 1%. A very similar growth rate is observed in Vision 2. In the case of Vision 3, NGC increases almost 450 GW, meaning an annual growth of around 2.3 %. Finally, in Vision 4, nearly new 700 GW of new capacity is incorporated in the ENTSO-E systems (approximately 3.3%/year).

	Vision 1, 2014-2030		Vision 2, 2014-2030		Vision 3, 2014-2030		Vision 4, 2014-2030	
	[%, annual yearly]	[GW]	[%, annual yearly]	[GW]	[%, annual yearly]	[GW]	[%, annual yearly]	[GW]
January 7 p.m.	0.94%	161	0.97%	167	2.34%	447	3.37%	698
July 11 a.m.	0.90%	155	0.94%	162	2.30%	442	3.31%	687

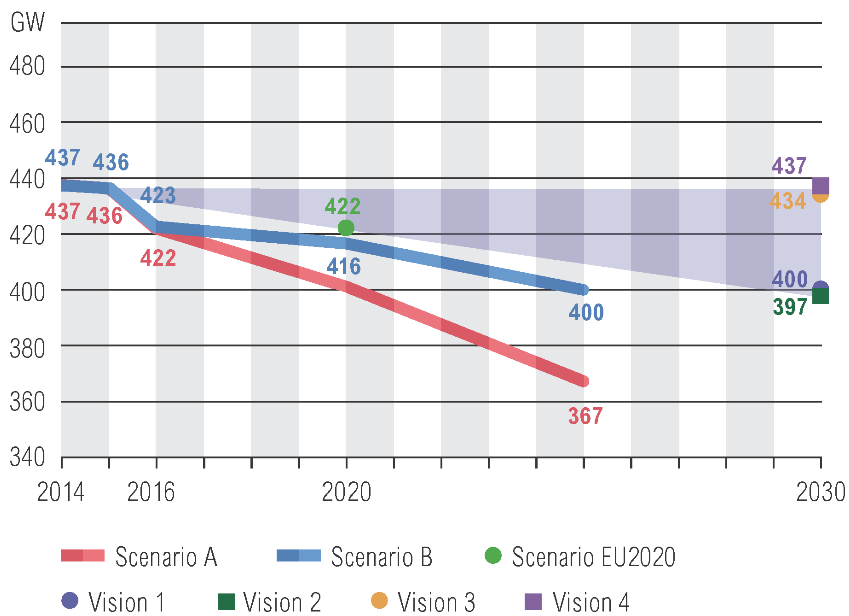
T. 3.2.1.6 - ENTSO-E NGC increase for Visions 1 to 4 with relation to Scenario B 2014

3.3 Fossil fuel generation capacity

Review of all Scenarios

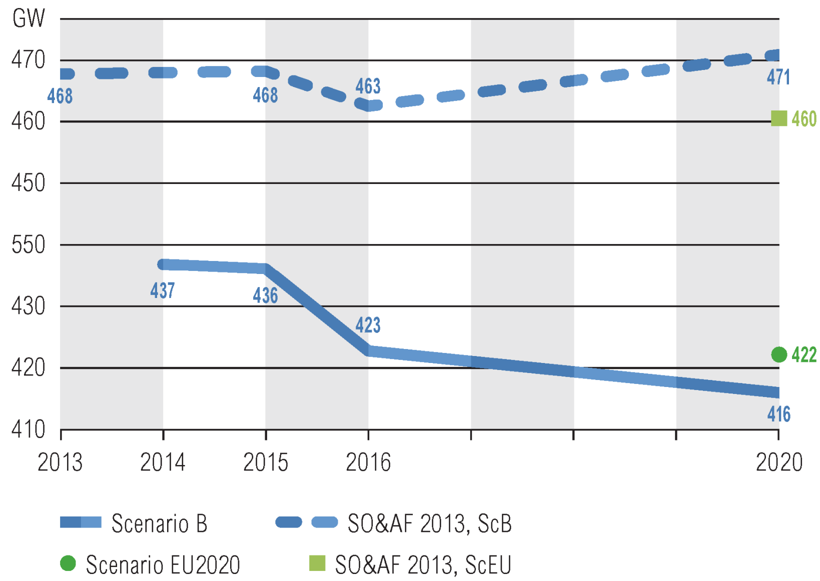
According to bottom-up scenarios, as seen in Figure 3.2.2.1., NGC of fossil fuel category is expected to be maintained in 2015 (436 GW) and to fall after in 2016 (to 422 GW in Scenario A and 423 GW in Scenario B). Until 2025, further decreases are expected, down to 400 GW in Scenario B and, even lower, down to 367 GW in Scenario A. In Scenario EU 2020 this category is kept at 2016 level.

Regarding long-term Visions, two main possible trends are foreseen. Vision 1 and Vision 2 look like plausible extensions of Scenario EU2020 (maintaining the same level of capacity that is indicated for Scenario B in 2025). On the other hand, Vision 3 and Vision 4 ñrecoverò fossil fuel to nearly the current level, between 434 GW and 437 GW.



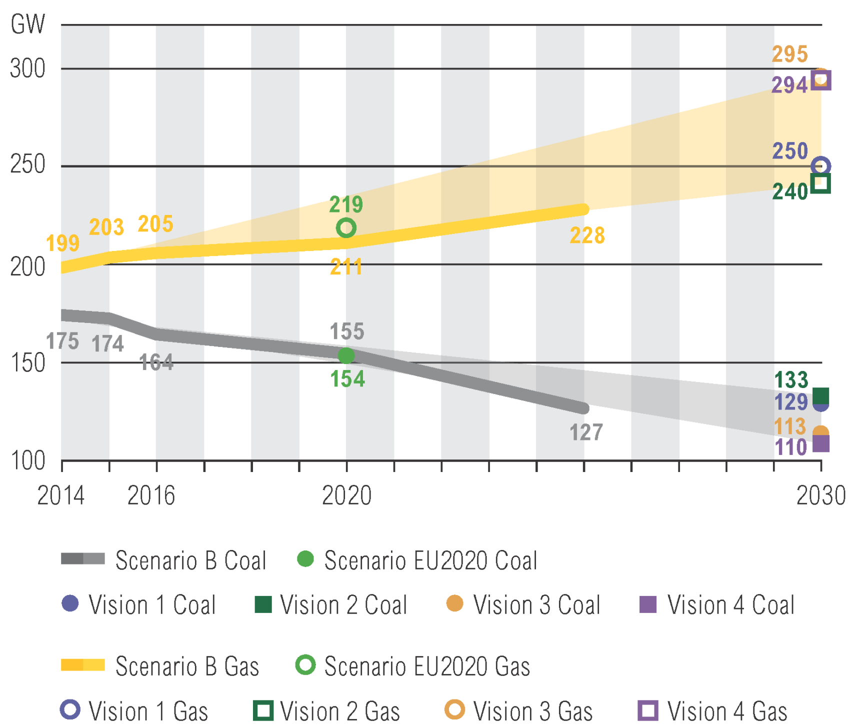
F. 3.2.2.1 - ENTSO-E Fossil fuels generation capacity forecast; all scenarios; January 7 p.m.. [GW]

When compared to the previous SO&AF report, fossil fuel capacity in Scenario B is lower, ranging between -7% (in 2014) and -12% (in 2020). With regards to Scenario EU 2020, capacity is 8% lower (-38 GW).

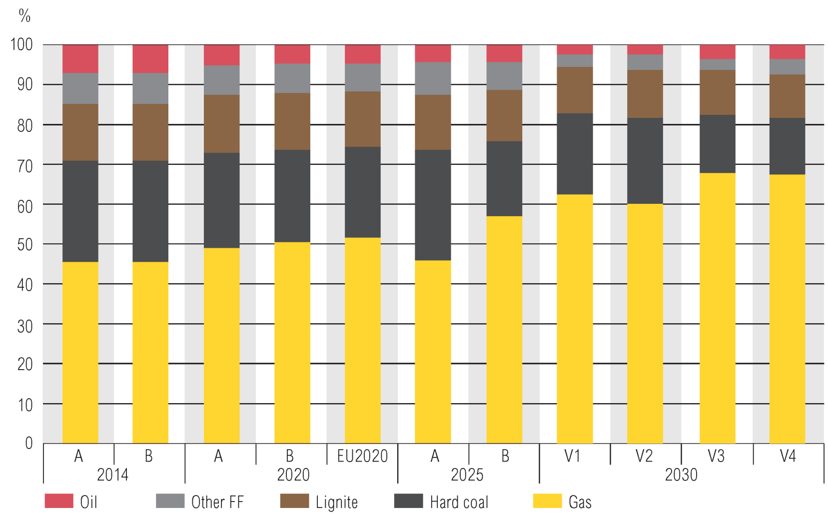


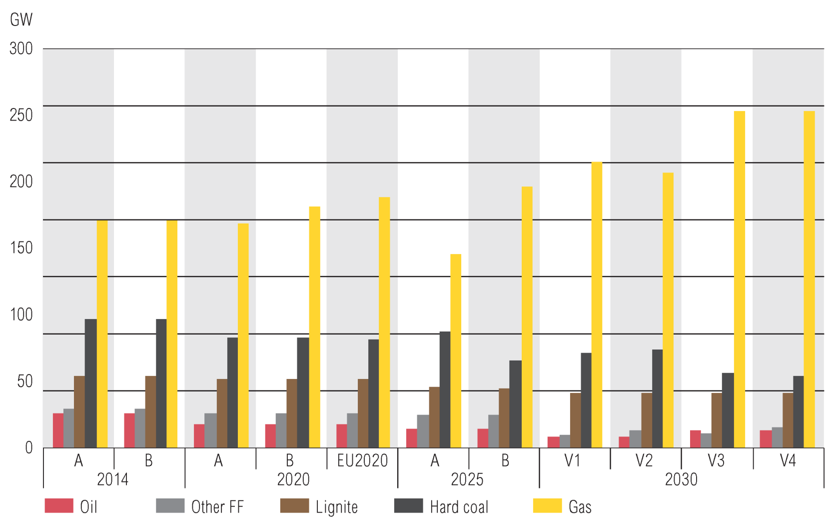
F. 3.2.2.2 – Comparison of Fossil fuels generation capacity between SO&AF 2013 and SO&AF 2014; scenarios B and EU2020; January 7 p.m. ***[GW]***

Along with the general decreasing trend of fossil fuels based capacity, a clear replacement trend of coal (as well as lignite, oil and other fuels) by natural gas is forecasted, as seen in Figure 3.2.2.3 and Figure 3.2.2.4. This is particularly apparent in Vision 3 and Vision 4, where the lowest values of coal based installed capacity are combined with the highest capacity of gas fuelled power plants.



F. 3.2.2.3 – ENTSO-E Coal (hard coal+lignite) and Gas generation capacity forecast; all scenarios; January 7 p.m. ***[GW]***





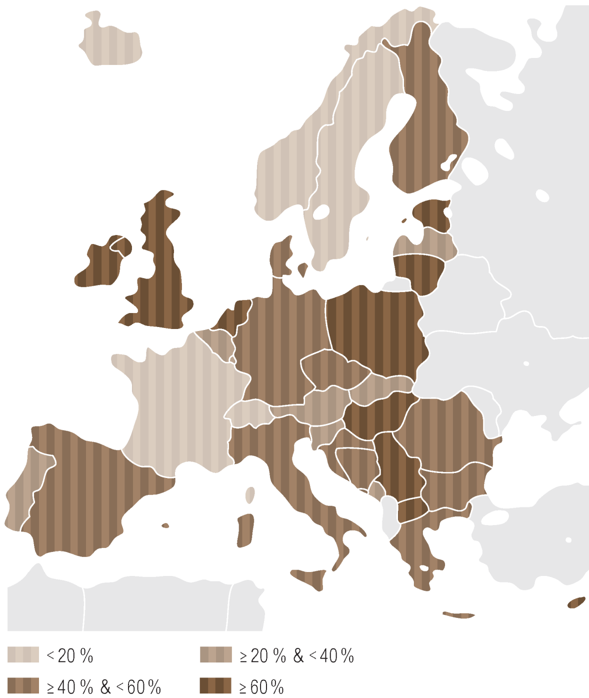
F. 3.2.2.4 - ENTSO-E Fossil fuels generation capacity breakdown in 2014, 2020 and 2030; all scenarios; January 7 p.m. (ratios and absolute values in GW)

Scenario A, B

The LCP Directive[2], which mandates old fossil fuel power plants to shut down (under certain conditions), seems to have very similar influences on Scenario A and B. Indeed, fossil fuel installed capacity is to decrease from 436 GW in 2015 to 423 GW (Scenario B) or to 422 GW (Scenario A) in 2016. Compared to former SO&AF report, the effects of LCP Directive are estimated to have more impact (13 GW against 6 GW). It may well be possible that some older fossil fuel units were then expected to remain in operation (probably after some planned retrofitting in order to fulfil environmental limits), but that is not foreseen any more.

[2] Directive 2001 / 80 / EC on the limitation of emissions of certain pollutants into the air from large combustion plants

Individual fossil fuel shares in NGC in Scenario B (in January) are depicted, by country, in Figure 3.2.2.5 and Figure 3.2.2.6. In both 2014 and 2020, the countries with the highest levels of fossil fuels are the Netherlands, Cyprus, Estonia and Poland.



F. 3.2.2.5 - Fossil fuels installed capacity as a part of NGC per country in 2014; Scenario B; January 7 p.m.

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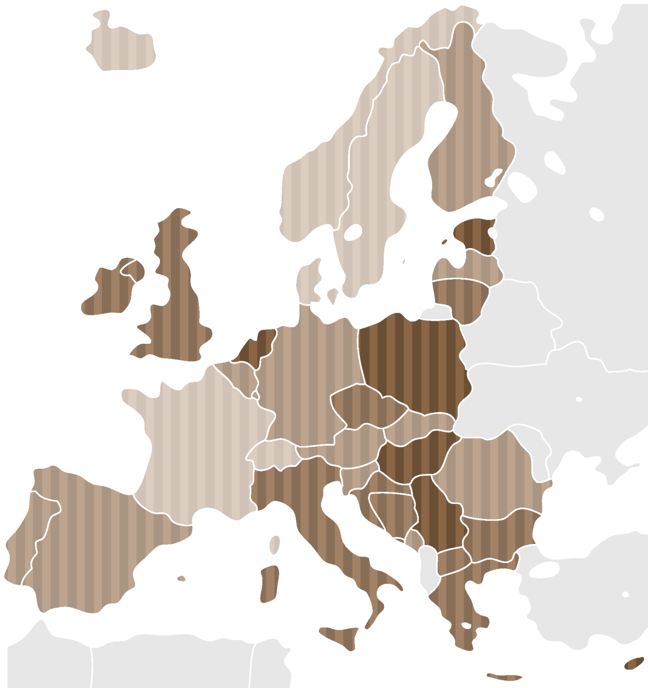
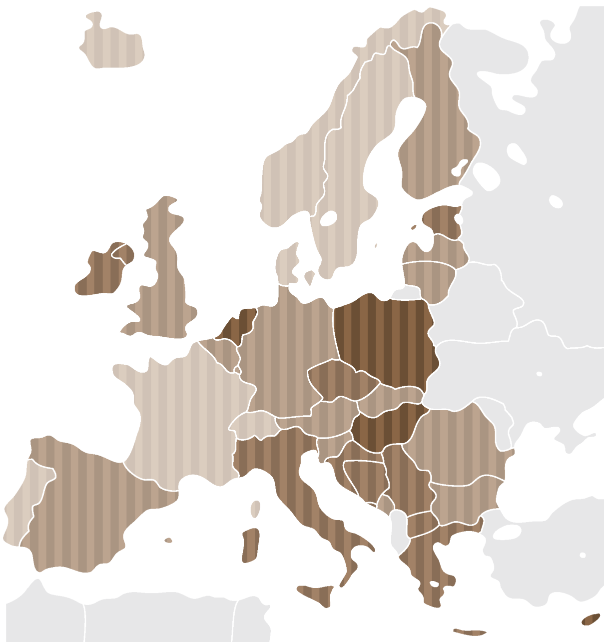


F. 3.2.2.6 - Fossil fuels installed capacity as a part of NGC per country in 2020; Scenario B; January 7 p.m.

Independent of Scenario (A or B) or season (January or July), for 2014 ï 2020 period, forecast annual growth rate of hard coal based capacity is always negative, ranging between -0.91 % and -3.53%.The same applies to lignite (between -1.55% and -1.7%) as well as oil and others (between -3.19% and -3.25%). In the case of natural gas fuelled power plants, this only happens in Scenario A (-1.47% to -1.48% yearly). In the case of Scenario B, total gas capacity increases by approximately 30 GW (annual growth of nearly 1.3%).



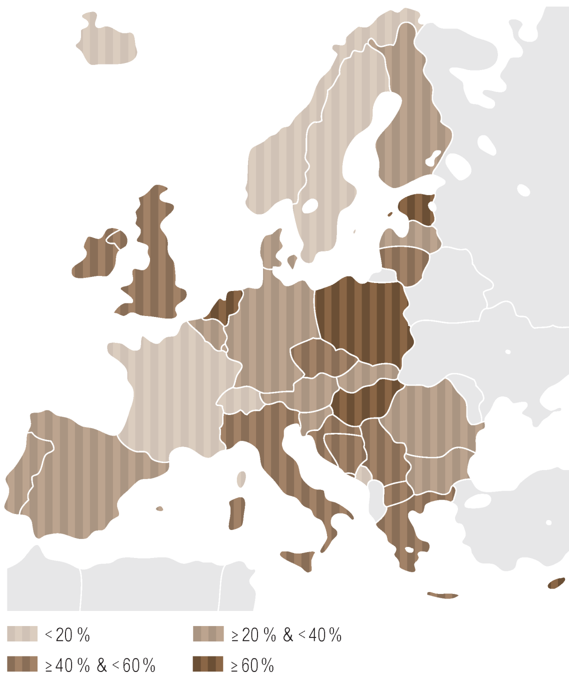
F. 3.2.2.7 - Fossil fuels installed capacity as a part of NGC per country in 2025; Scenario B; January 7 p.m.

	Scenario	2014-2025	Hard coal	Lignite	Gas	Oil and other
January 7 p.m.	A	[GW, total]	-11	-10	-30	-19
		[%, yearly]	-0.92%	-1.57%	-1.48%	-3.19%
	B	[GW, total]	-37	-11	29	-19
		[%, yearly]	-3.52%	-1.70%	1.27%	-3.23%
July 11 a.m.	A	[GW, total]	-11	-10	-30	-20
		[%, yearly]	-0.91%	-1.55%	-1.47%	-3.25%
	B	[GW, total]	-36	-11	30	-19
		[%, yearly]	-3.50%	-1.68%	1.28%	-3.23%

T. 3.2.2.1 – ENTSO-E Fossil fuels subcategories evolution for Scenarios A and B

Scenario EU 2020

In Scenario EU 2020, as shown in Figure 3.2.2.8, Cyprus, Hungary, Estonia, The Netherlands and Poland are the countries with more than 60 % of fossil fuels installed capacity.



F. 3.2.2.8 - Fossil fuels installed capacity as a part of NGC per country in 2020; Scenario EU 2020; January 7 p.m.

Compared to Scenario B, the major differences of Scenario EU 2020 lie in higher levels of gas based capacity, with additional 8 to 10 GW, depending on the season. In the case of remaining fuels, smaller values are observed, not higher than 2 GW.

	Scenario Eu2020 to scenario B	Hard coal	Lignite	Gas	Oil and other
January 7 p.m.	[GW]	-1	0	8	0
	[%]	-1.30%	-0.29%	3.83%	-0.77%
July 11 a.m.	[GW]	-1	0	10	-2
	[%]	-1.31%	-0.62%	4.68%	-3.93%

T. 3.2.2.2 – Differences of ENTSO-E Fossil fuels subcategories in scenario EU2020 with relation to scenario B

2030 Visions

Comparing the most contrasting Visions 1 and 4, despite the lower fossil fuels share the NGC of Vision 4 with relation to Vision 1, the absolute value is higher than in Vision 1 by more than 36 GW (see Table 3.2.2.3).

	Vision 4 to Vision 1	
	[%]	[GW]
January 7 p.m.	9.07%	36.33
July 11 a.m.	9.14%	36.63

T. 3.2.2.3 - Difference of ENTSO-E Fossil fuels generation capacity in Vision 4 with relation to Vision 1

Differences between Vision 1 and Vision 4 can also be shown as proportions of the NGC of Scenario B in 2014, and of Vision 1 (in 2030), depicted in Table 3.2.2.4.

	Vision 4 to Vision 1 as part of NGC in Scenario B 2014	Vision 4 to Vision 1 as part of NGC in Vision 1
	[%]	[%]
January 7 p.m.	3.64%	3.13%
July 11 a.m.	3.65%	3.16%

T. 3.2.2.4 - Differences of ENTSO-E Fossil fuels generation capacity in Vision 4 with relation to Vision 1 as part of total NGC

By 2030, only Estonia is forecasting more than 70% of installed capacity based on fossil fuels. Compared to Vision 1, in Vision 4, the share of capacity based on fossil fuels is to decrease in almost all countries, mainly due to the higher RES penetration assumptions under this vision. Nevertheless, it is important to note that this is only regarding installed capacity and not energy production share.

This is particularly the case for Denmark (-32 p.p.), Estonia (-27 p.p.) and Serbia (-23 p.p.), whereas the only country indicating a higher share of fossil in Vision 4 is Switzerland (+0.6 p.p.).

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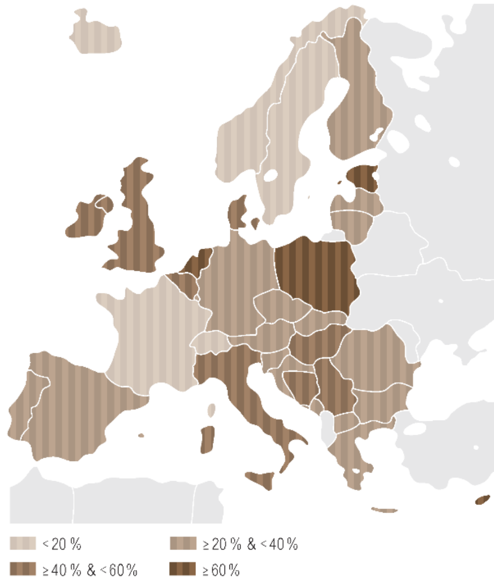


F 3.2.2.9 - Fossil fuels installed capacity as a part of NGC per country in 2030; Vision 1; January 7 p.m.

F 3.2.2.10 - Fossil fuels installed capacity as a part of NGC per country in 2030; Vision 4; January 7 p.m.

3.4 Nuclear generation capacity

Review of all Scenarios

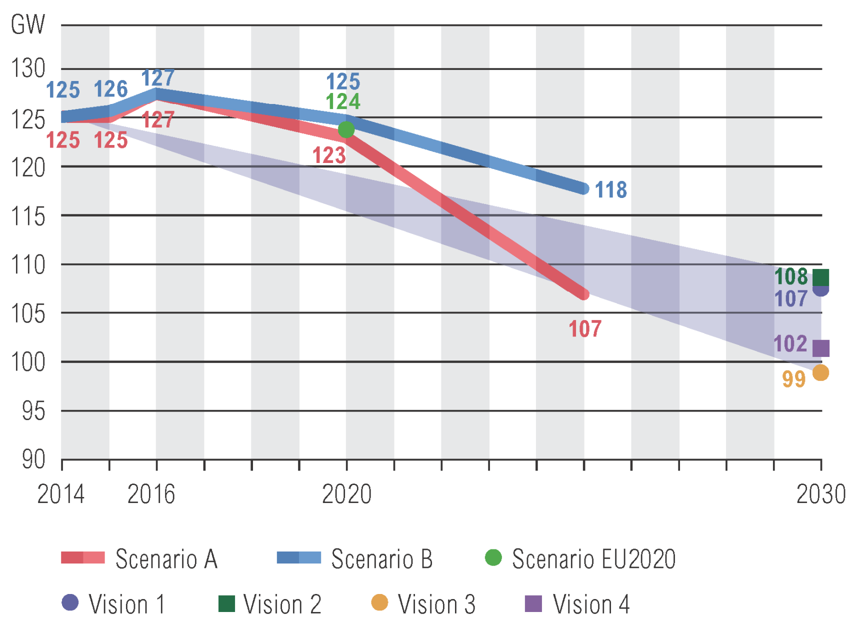
Over the next years, ENTSO-E nuclear capacity will slightly increase given the commissioning of sufficient new units compensating the start of decommissioning of certain power plants in Germany (1.28 GW to be dismissed from 2015 to 2016). New power plants are to be commissioned in Finland (+1.6 GW), France (+1.6 GW) and Slovakia (+0.88 GW) over the next two years.

Following this, a decrease will be observed until 2020, which will become even more relevant by 2025. This can be explained by the Germanyös decision to gradually shut down its nuclear power plants. In addition to this, the Franceös reduction by 3GW, corresponding to 5% of nuclear NGC, is less significant than the Belgiumös by 40% of nuclear capacity, on a related basis.

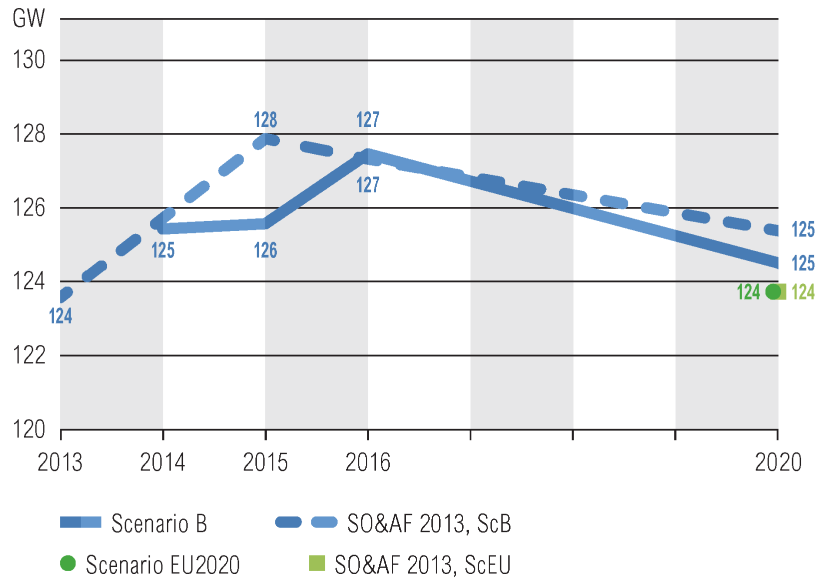
Such trends are aligned in both the ñconservativeò and the ñbest estimateò scenario.

Scenarios A, B

The increasing difference between scenario A and B in 2025 (see figure 3.2.3.1) is related to the uncertain commissioning of new power plants, mainly in Great Britain (5GW), and afterwards in Poland (1.5 GW), Romania (1.3 GW), Lithuania (1.3 GW) and Finland (1.2 GW).



F. 3.2.3.1 – ENTSO-E Nuclear generation capacity forecast; all scenarios; January 7 p.m. [GW]

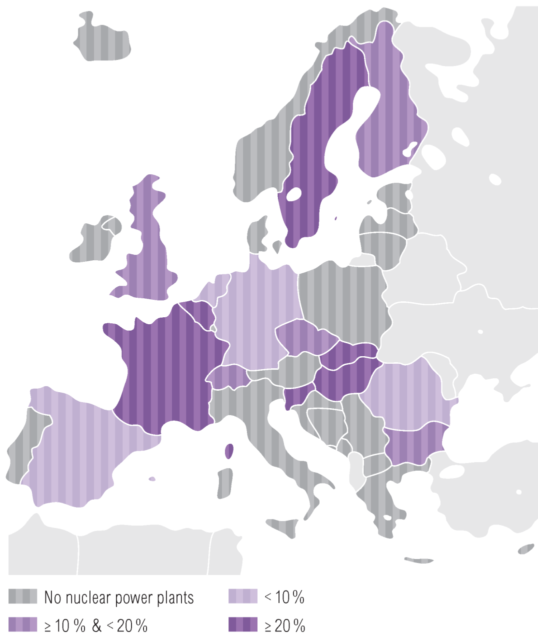


F. 3.2.3.2 – Comparsion of nuclear generation capacity between SO&AF 2013 and SO&AF 2014; Scenarios B and EU2020; January 7 p.m. ***[GW]***

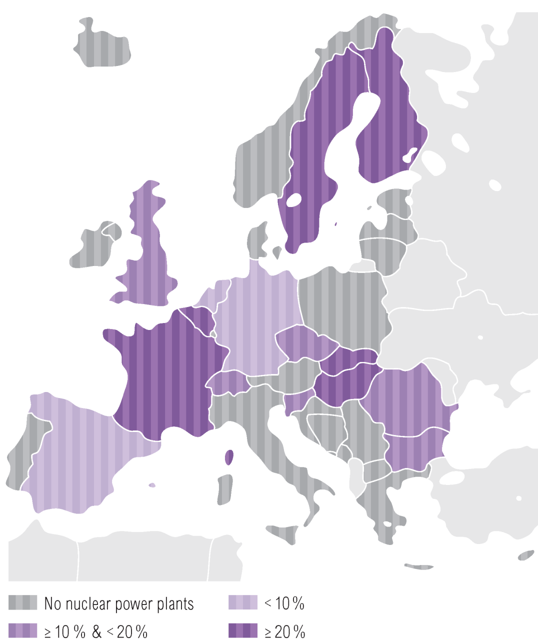
Short to medium-term forecasts are largely aligned with previous appraisals (SO&AF 2013-2030), reflecting the fact that long-term decisions on nuclear investments are less volatile.

In terms of nuclear weight in the NGC in Scenario B, France will maintain its leading position with more than 43% share in 2025.

Furthermore, most of the fluctuations of nuclear share in NGC (Figures 3.2.3.3 - 3.2.3.4) are connected to the fluctuations of the NGC and not to the fluctuations of nuclear capacity itself. In Slovenia, for instance, the nuclear footprint among NGC will be dropping from 22% (2014) to 14% (2025), and presents a variation that has to be related to a raise in the total NGC capacity, with a constant nuclear installed capacity.



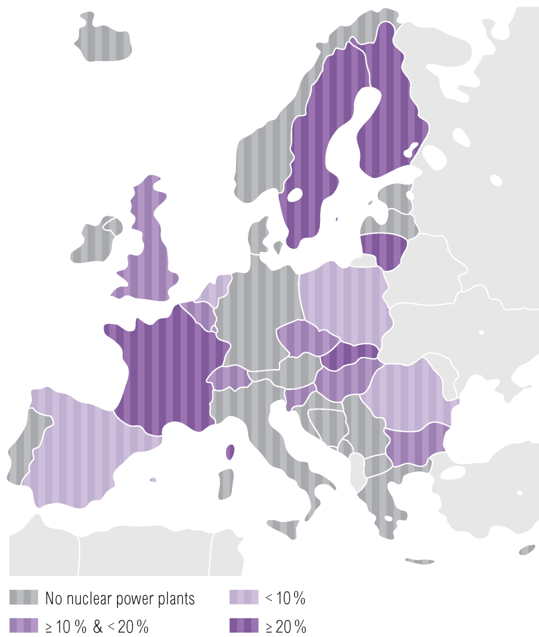
F. 3.2.3.3 – Nuclear installed capacity as part of NGC per country in 2014; Scenario B; January 7 p.m.



F. 3.2.3.4 – Nuclear installed capacity as part of NGC per country in 2020; Scenario B; January 7 p.m.

On the contrary, Finland is raising its capacity from 16% to 26% between 2014 and 2025 (with new power plants to be installed for a total 2.8 GW), as well as Romania which is reaching 1.3 GW (with a raise from 6% to 10% in terms of Nuclear as part of NGC).

The growth in Slovakia by 1 GW of its nuclear installed capacity, despite a moderate raise of its total NGC, will lead an increase of nuclear share within NGC from 24% by 2014 to 33% by 2025.



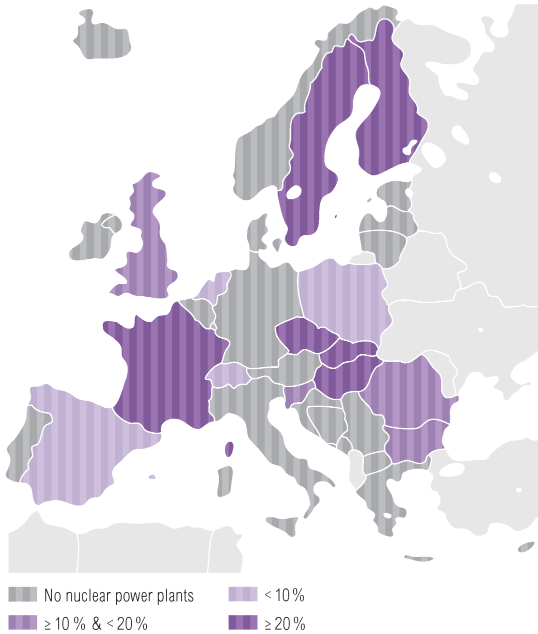
F 3.2.3.5 - Nuclear installed capacity as a part of NGC per country in 2025; Scenario B; January 7 p.m.

Scenario EU 2020

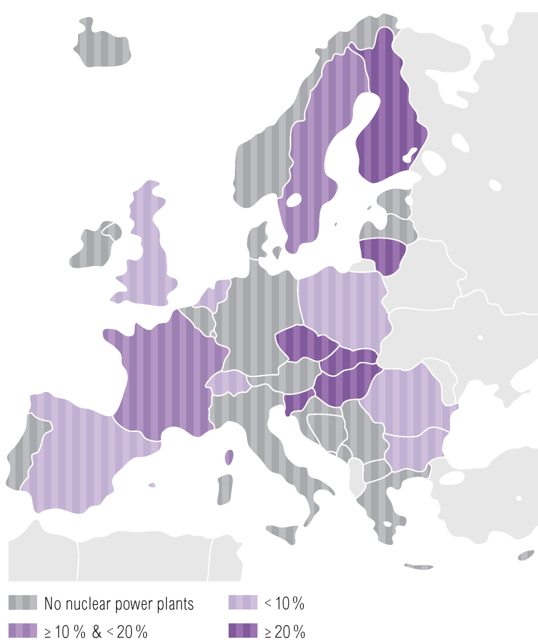
The situation in Scenario EU 2020 is very similar to that of Scenario B, which confirms that national policy views and TSO estimates are coherent when it comes to the nuclear issue. All countries are in the same range as shown on the map for Scenario B, with the only difference in Hungary, where the decrease from 21% to 17% is only due to the slightly higher total NGC.

Scenario Vision 1 and Vision 4

Concerning the Visions two main remarks have to be taken into account. First of all, as regards to the nuclear, the Visions are very close to each other, given that every country makes its own decisions on the matter. Secondly, in comparing Vision 1 and Vision 4, the weight of Nuclear in Europe is dropping from 9% to 6%: this consequence is exclusively due to a significant growth of renewables in Vision 4, and consequently of the NGC, absolute values being constant under all Visions.



F 3.2.3.6 - Nuclear installed capacity as a part of NGC per country in 2030; Vision 1; January 7 p.m.



F 3.2.3.7 - Nuclear installed capacity as a part of NGC per country in 2030; Vision 4; January 7 p.m.

	Vision 4 to Vision 1

	[%]	[GW]
January 7 p.m.	-4.40%	-4.71
July 11 a.m.	-4.40%	-4.71

T 3.2.3.1 - Difference of ENTSO-E Nuclear generation capacity in Vision 4 with relation to Vision 1

In Table 3.2.3.2 the differences between Vision 1 and Vision 4 are shown in terms of proportion of whole generation of both Scenario B in 2014 and Vision 1 (in 2030).

	Vision 4 to Vision 1 as part of NGC in Scenario B 2014	**Vision 4 to Vision 1 as part of NGC in Vision 1**
	[%]	**[%]**
January 7 p.m.	-0.47%	-0.41%
July 11 a.m.	-0.47%	-0.41%

T 3.2.3.2 - Differences of ENTSO-E Nuclear generation capacity in Vision 4 with relation to Vision 1 as part of total NGC

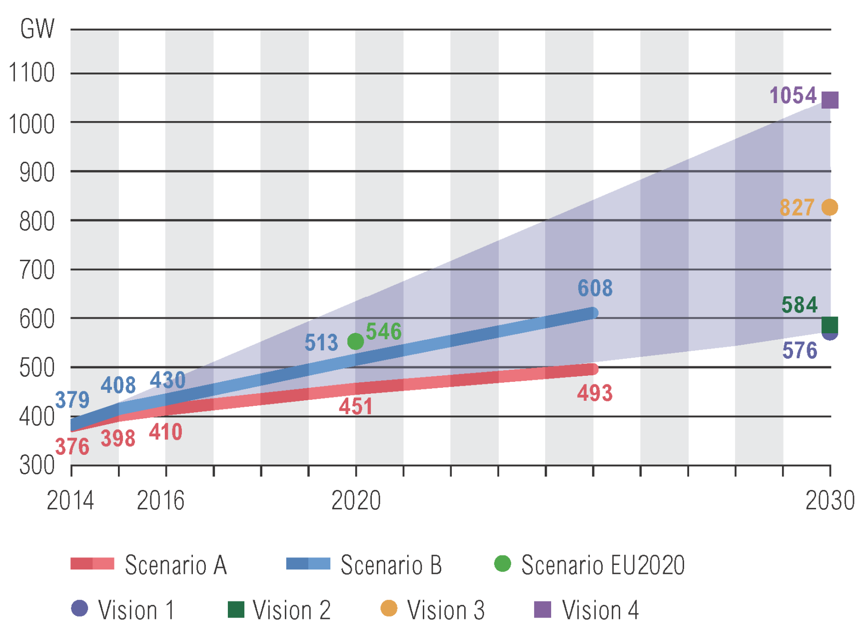
3.5 Renewable energy sources

In this chapter, renewable energy sources (ñRESò), including renewable hydro power plants (thereinafter as ñHPPò), are assessed and are jointly referred to as ñtotal RESò. However, evaluations, statements and maps in this paragraph may be slightly biased; it is not straightforward to divide total hydro power plantsô installed capacity into requested sub-categories in every countryõs individual case, thus making the proper distinction between individual sub-categories of hydro power plants impossible. The main issue for TSOs is to identify the renewable generating capacity in hydro power units which combine the possibility of pump storage with natural inflow (pure pump storage is not recognised as RES). Hence, TSOs are not always able to identify whether or not the hydro capacity can be classified as RES capacity, although this is not true for actual generation. When the result or evaluation in the text is influenced by this fact, the reader is warned early. As RES HPP, the run-of-river and natural inflow storage HPP are considered, which can be applied for most of the ENTSO-E countries. Pure pumped storage HPP and the pumping part of mixed natural inflow and pump storage power plants are classified as non-RES HPP.

Review of all Scenarios

As a result of the European energy and climate policy, RES power category grew in the past year at a very fast pace. However, the speed of growth has reduced over the past years due to a global and adverse macro economical context, along with the revision of the incentive schemes applied by some countries, which have been decisive for the outstanding growth rate.

The RES development over the next few years will be closely determined by two major factors: firstly, the decisions made by each country in terms of potential incentive policies to be implemented individually, in line with the framework presented by the European Commission on 22 January 2014, secondly the wide uncertainty nowadays regarding the moment when *grid parity* will effectively be reached.



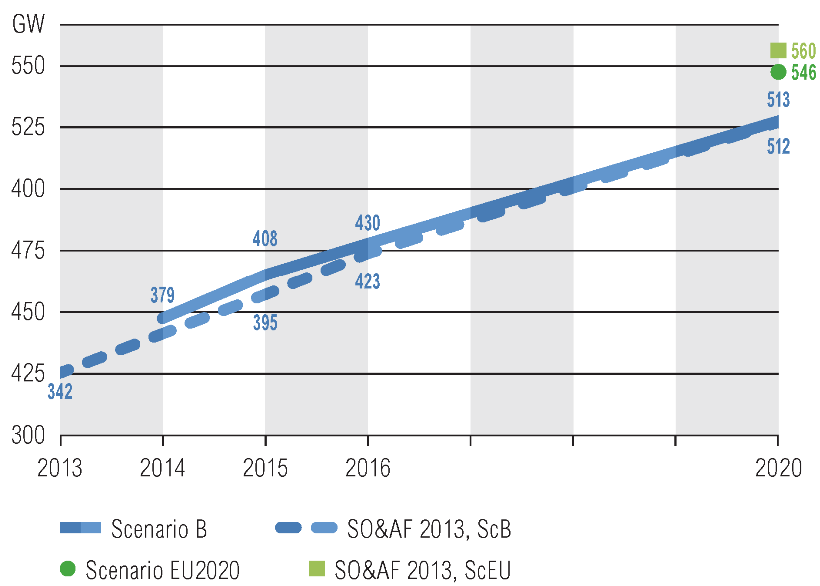
F. 3.2.4.1 – ENTSO-E RES generation capacity forecast; all scenarios; January 7 p.m. ***[GW]***

Figure 3.2.4.1 shows the evolution of total RES installed capacity in the different Scenarios. Starting from 379 GW in 2014 (compared to 332 GW in 2013), the RES amount will increase to 513 GW in 2020 and further to 608 GW in 2025 (Scenario B).

The gap among Scenario A and Scenario B is growing progressively in the timeline until 2020, and in an even more significant way between 2020 and 2025.

Towards 2030, the different Visions reflect the major difference between the various renewable policies. In Vision 1 and 2, the general guidelines assume that no new policies are put into place to stimulate RES development, thus resulting in almost no expected new renewable capacity after 2020. Conversely, in Vision 3 and 4 the political goals are continued towards new targets for 2030 and are in line with the EU objectives for 2050.

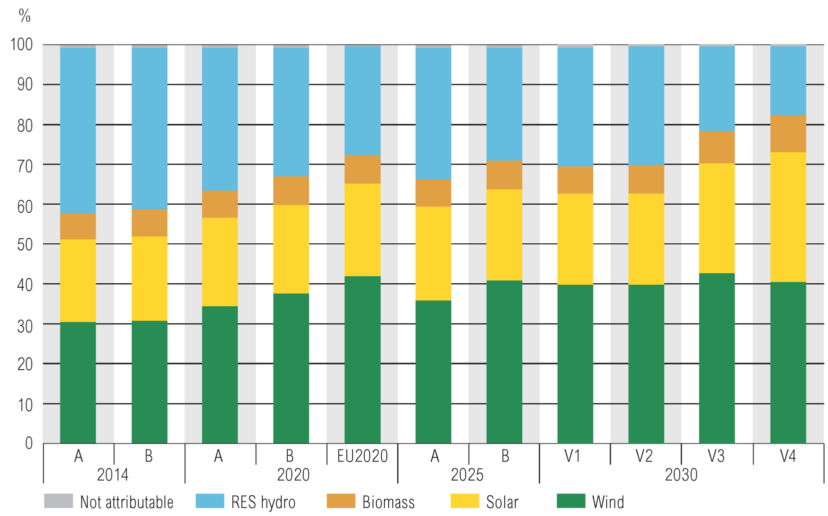
As highlighted in the methodology chapter, 2030 is half way between 2020 and 2050ôs European energy targets. The aim of ñ2030 visions approachò should be that the pathway realized in the future falls with a high level of certainty in the range described by the visions. The visions are not forecasts and there is no probability attached to the visions.

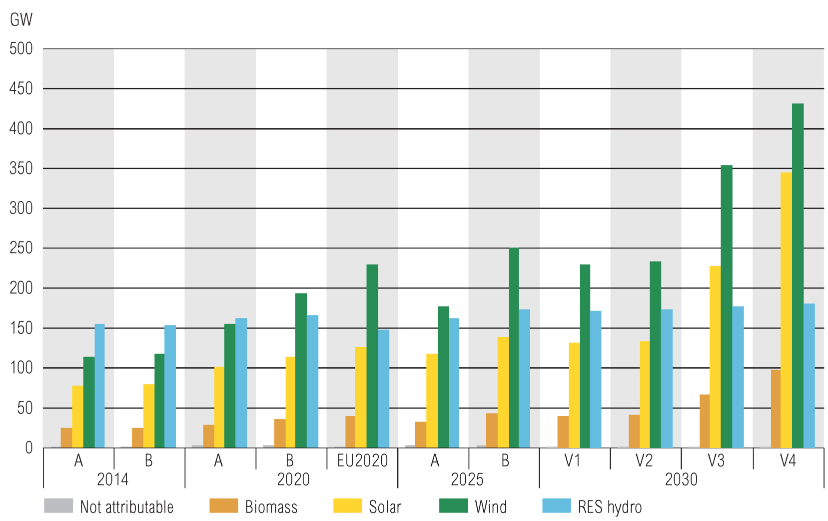


F. 3.2.4.2 – Comparison of RES generation capacity between SO&AF 2013 and SO&AF 2014; Scenarios B and EU2020; January 7 p.m. ***[GW]***

When looking closer at the RES generation capacity breakdown (relative and absolute values) in 2014, 2020, 2025 and 2030 (Figure 3.2.4.3) two main observations arise.

First of all, the 20-20-20 wind target appears to be challenging to be reached on time: it remains substantially higher than TSOs best estimate forecast for 2020 (Scenario B). Furthermore, the relative share of hydro within RES is considerably reduced. The absolute hydro-values remain nearly stable, however when compared to the fast growing RES-sector, their relative share is decreasing. This might be a warning for the operation of the power systems, as wind and solar units do not have the flexibility for balancing the power system which some hydro units are able to provide.

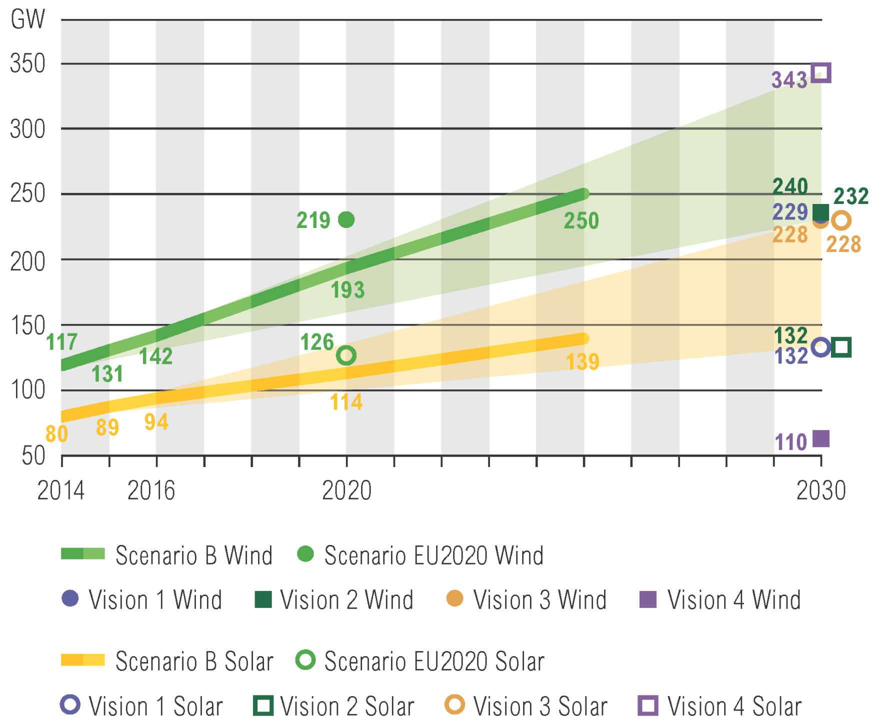




F. 3.2.4.3 – ENTSO-E RES generation capacity breakdown; all scenarios; January 7 p.m.

Among the different RES energy types, the different Scenarios / Visions show that wind capacity is the fastest growing type, followed by solar. A comparison of these two RES-types is shown in Figure 3.2.4.4.

Wind is expected to grow from 117 GW in 2014 (compared to 106 GW in 2013), to a 2030 level ranging from 230 GW (Vision 1) to 430 GW (Vision 4). Solar is expected to grow from a capacity of 80 GW in 2014 (compared to 70 GW in 2013) to a 2030 level ranging from 133 GW (Vision 1) to 344 GW (Vision 4).



F. 3.2.4.4 – ENTSO-E Wind and Solar generation capacity forecast; all scenarios; January 7 p.m. ***[GW]***

Scenario A, B

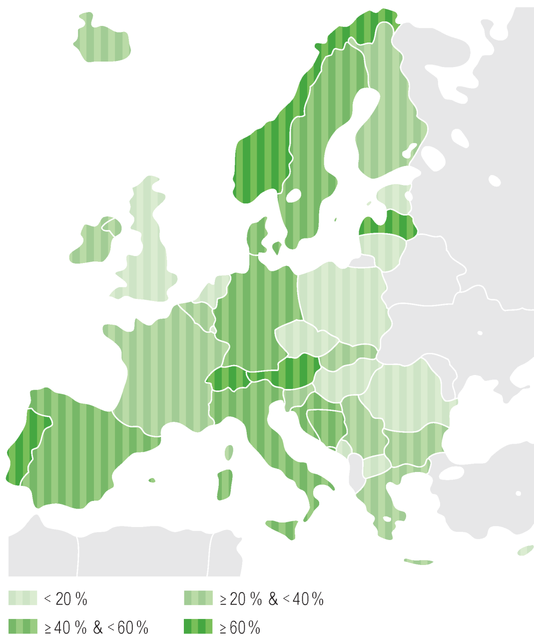
Figures 3.2.4.5 - 3.2.4.7 show the share of RES as part of the total NGC of each ENTSO-E country for Scenario B in 2014, 2020 and 2025. The average ENTSO-E RES weight is expected to grow from 38% (foreseen in 2014), to 46% by 2020 and 51% by 2025. The majority of the countries have a lower share of total RES than the ENTSO-E average meaning a relative concentration of most RES development to a limited number of countries, but in order to avoid any possible bias due to the size of a system, it is recommended to consider each country individually.

In terms of RES weight in the NGC in Scenario B, aside from that report showing that Norway will maintain its leading position with a steady 94%, it is interesting to focus on countries which undergo a significant change other the next years.

Germany is the country where a major growth regarding the absolute terms is forecasted, with an increase of 33 GW from 2014 to 2020 (56 GW if looking at horizon 2025) which will impact on RES weight in the NGC, increasing from 43% in 2014, up to 54% foreseen by 2020 (61% by 2025).

Concerning the relative terms, an even more substantial growth is forecasted in Greece (from 2014 and 2025 RES power installed will triple), in the Great Britain (where the capacity to be installed from 2014 to 2025 will triple RES weight on NGC), and in Denmark (with a growth concentrated over the years until 2020, RES weight in NGC is expected to grow from 59% in 2014 to 82% by 2025).

Netherlands and Northern Ireland are other two control areas in which, according to the best estimate TSOÕs forecast, RES power installed is to triple between 2014 and 2025. Regarding Netherlands, and given the decisive development of off-shore wind power plants, the total RES power will be growing from 4 GW to 13 GW between 2014 and 2025. In Northern Ireland, the installation of 1.33 GW contributes to RES growth in the NGC from 22% in 2014 to 53% foreseen by 2025.



F. 3.2.4.5 – RES installed capacity as part of NGC per country in 2014; Scenario B; January 7 p.m.

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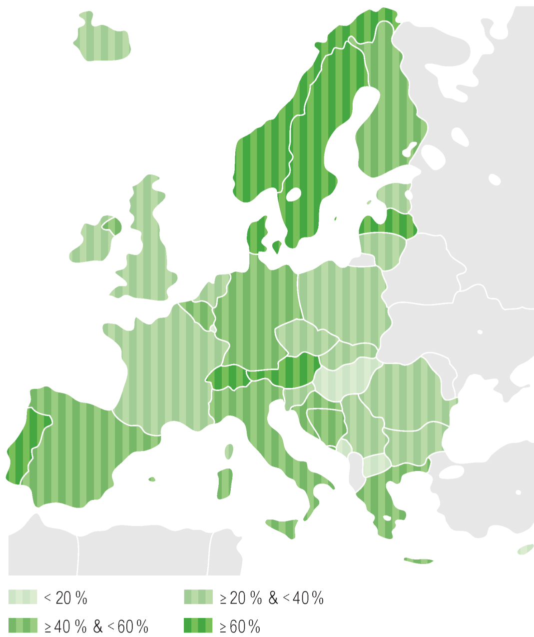
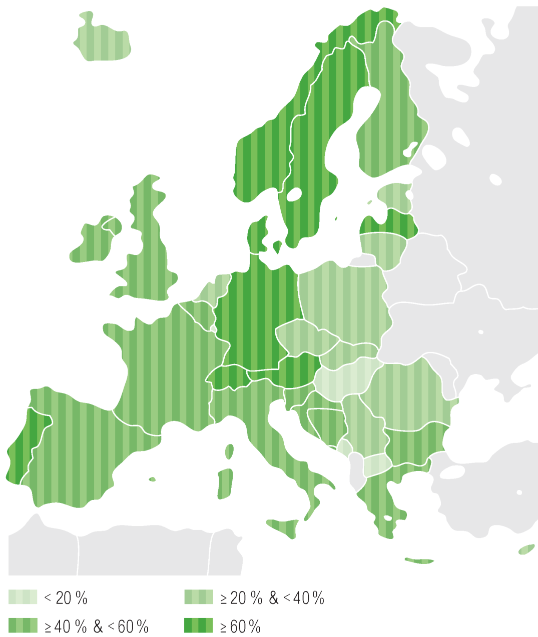


F. 3.2.4.6 – RES installed capacity as part of NGC per country in 2020; Scenario B; January 7 p.m.

Comparing figures 3.2.4.5, 3.2.4.6 and 3.2.4.7, it seems interesting to point out that except from Germany and Denmark undergoing a significant shift towards RES, all other countries characterized by their RES weight in the NGC higher than 60% in 2025 are already in or near the same range in 2014: this applies to Austria, Switzerland, Latvia, Norway, Portugal and Sweden[3].

[3]In Sweden RES weight in the NGC in 2014 is 59.76%.



F. 3.2.4.7 – RES installed capacity as part of NGC per country in 2025; Scenario B; January 7 p.m.

	Scenario	2014-2025	Wind	Solar	Biomass	RES hydro
January 7 p.m.	A	[GW, total]	62	38	8	8
		[%, yearly]	4.03%	3.70%	2.43%	0.44%
	B	[GW, total]	133	59	17	19
		[%, yearly]	7.13%	5.20%	4.68%	1.09%
July 11 a.m.	A	[GW, total]	60	37	8	8
		[%, yearly]	3.79%	3.44%	2.43%	0.43%
	B	[GW, total]	130	57	17	19
		[%, yearly]	6.87%	4.91%	4.68%	1.09%

Table 3.2.4.1 – ENTSO-E RES subcategories evolution; Scenarios A and B

Scenario EU 2020

Figure 3.2.4.7 shows the share of RES as part of the total NGC for each ENTSO-E country for Scenario EU 2020. The situation in Scenario EU 2020 is very similar to that of Scenario B; furthermore, regarding the countries with different range between figure 3.2.4.6 and 3.2.4.7, it should be noted that this is more often due to the difference in total NGC rather than the slight difference in RES installed capacity.

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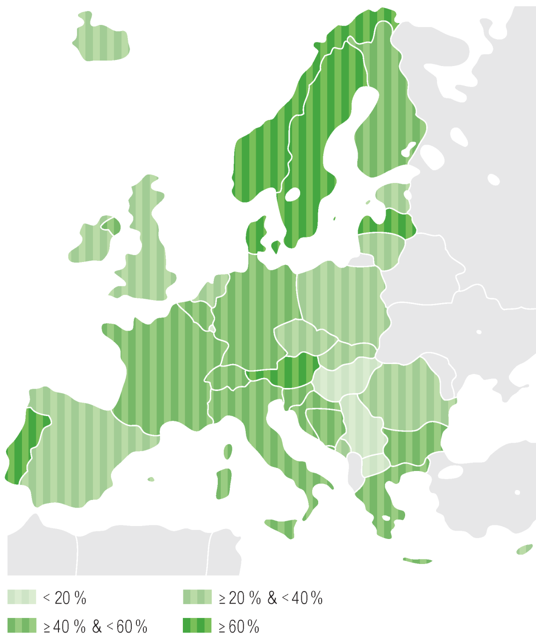


F. 3.2.4.8 – RES installed capacity as part of NGC per country in 2020; Scenario EU2020; January 7 p.m.

The difference between RES development for Scenario B and Scenario EU 2020 for different production types is shown in Table 3.2.4.2. The biggest difference for the two Scenarios is for wind, where Scenario EU 2020 shows an estimate of 36 GW more wind than in Scenario B.

	Scenario Eu2020 to scenario B	Wind	Solar	Biomass	RES hydro
January 7 p.m.	[GW]	36	13	3	-18
	[%]	18.85%	11.37%	8.10%	-10.72%
July 11 a.m.	[GW]	37	13	3	-18
	[%]	18.92%	11.63%	8.22%	-10.74%

Table 3.2.4.2 – Differences of RES subcategories in Scenario EU2020 compared to Scenario B

Scenario Vision 1 and Vision 4

With regards to Vision 1, the total RES capacity is expected to be 576 GW, which is 50 % of the total NGC. In of Vision 4, the total RES capacity is expected to be 1 054 GW, which accounts for 62 % of the total NGC. The difference of RES generation capacity for Vision 1 and Vision 4 for different production types is shown in Table 3.2.4.3.

		Vision 4 to Vision 1	Total RES	Wind	Solar	Biomass	RES hydro
January 7 p.m.		[GW]	478	200	211	58	9
		[%]	82.99%	87.40%	159.70%	144.17%	5.24%
July 11 a.m.		[GW]	472	201	211	52	9
		[%]	81.87%	87.32%	158.88%	129.82%	5.25%

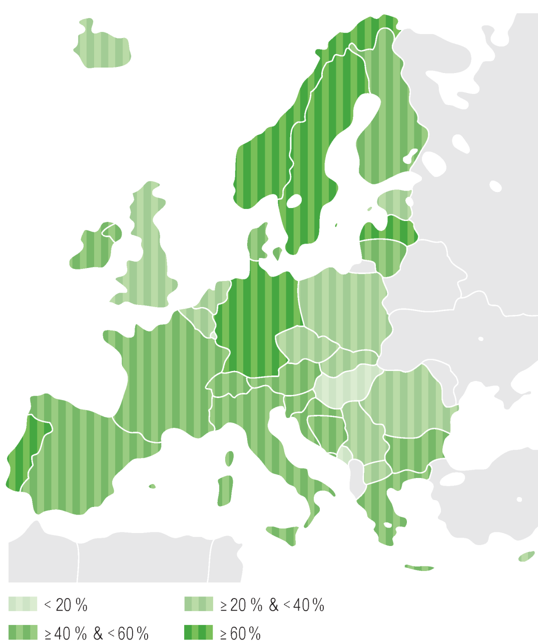
Table 3.2.4.3 - Difference of ENTSO-E RES generation capacity in Vision 4 with relation to Vision 1

	Vision 4 to Vision 1 as part of NGC in Scenario B 2014	Total RES	Wind	Solar	Biomass	RES hydro
January 7 p.m.	[%]	47.89%	20.06%	21.15%	5.82%	0.90%
July 11 a.m.	[%]	47.01%	19.97%	20.98%	5.20%	0.89%

Table 3.2.4.4 - Differences of ENTSO-E RES generation capacity in Vision 4 with relation to Vision 1 as part of total NGC

In total, Vision 4 has more than 478 GW total RES capacity over that of Vision 1. The largest difference between the two visions can be observed for Solar, where Vision 4 displays 211 GW higher figures.

Figures 3.2.4.9 and 3.2.4.10 show the share of RES as part of the total NGC for each ENTSO-E country for the year 2030 for Vision 1 and Vision 4.



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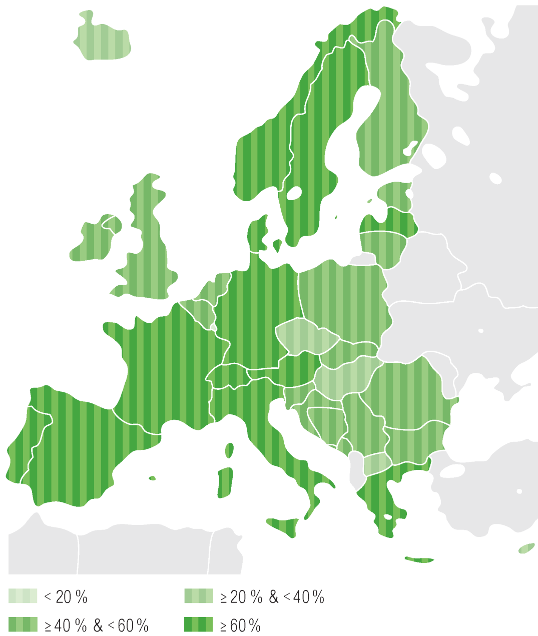
F. 3.2.4.9 – RES installed capacity as part of NGC per country in 2030; Vision 1; January 7 p.m.



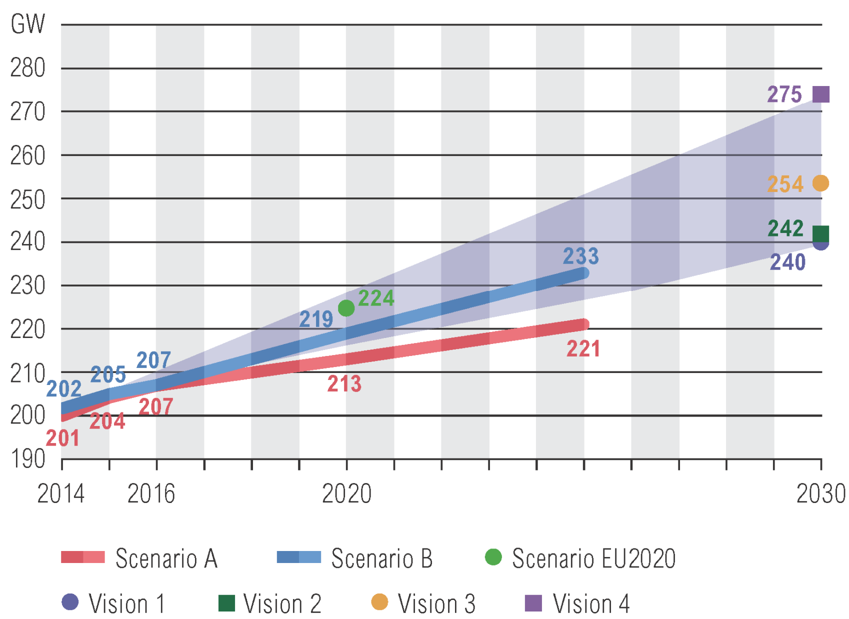
F. 3.2.4.10 – RES installed capacity as part of NGC per country in 2030; Vision 4; January 7 p.m.

3.6 Non-renewable hydro generation capacity

In the RES HPP category, both run-of-river and natural inflow storage HPP are considered; in addition to these, non-RES HPP, such as pure pumped storage HPP and pumping part of mixed natural inflow and pump storage power plants, are included as well.

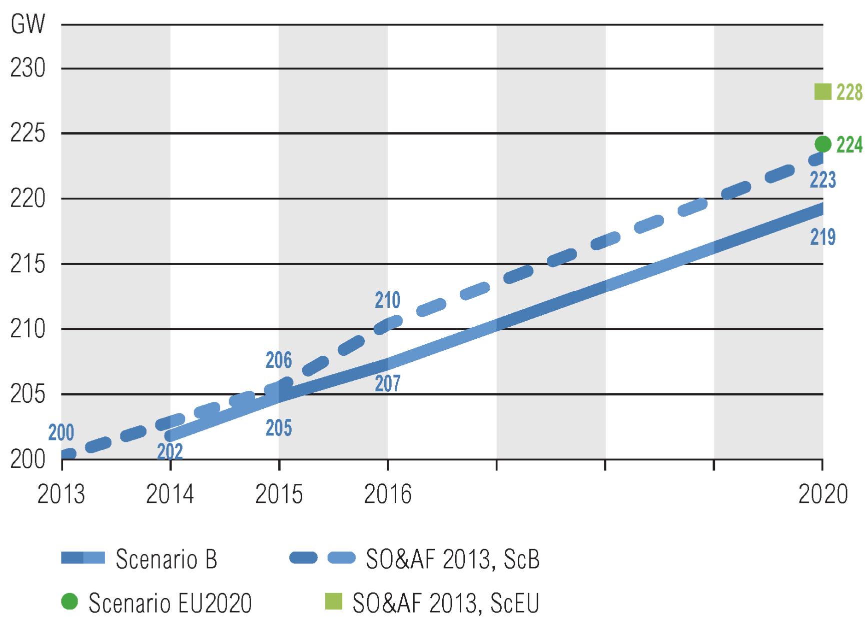
Review of all Scenarios

Figure 3.2.5.1 shows the evolution of total hydro power plants (HPP) installed capacity in the different Scenarios. From a level of 202 GW today it is expected to grow to 219 GW by 2020 and to 233 GW by 2025 (Scenario B). Towards 2030, the different Visions reflect relatively small differences for hydro.



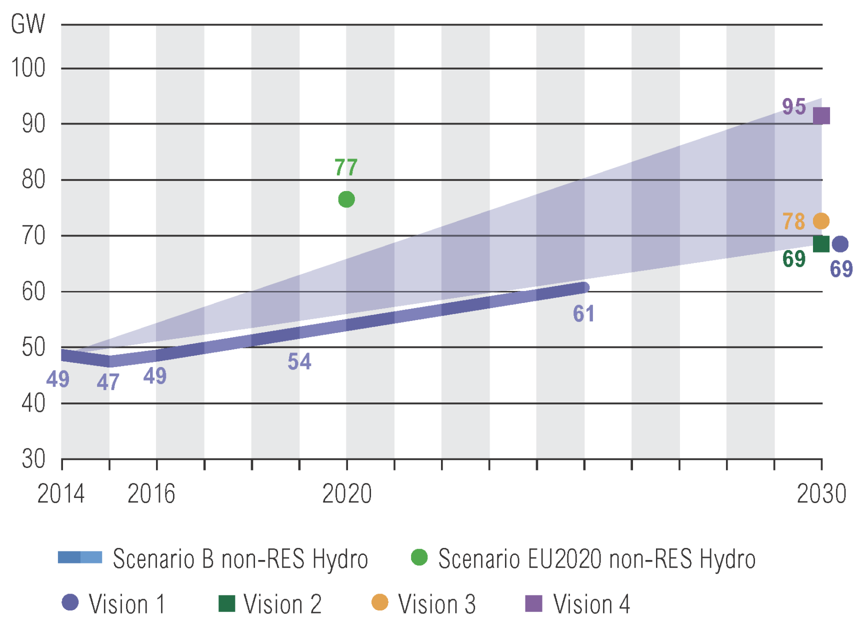
F. 3.2.5.1 – ENTSO-E total HPP generation capacity forecast; all scenarios; January 7 p.m. ***[GW]***

A comparison of total HPP generation capacity for SO&AF 2013 and SO&AF 2014 (Figure 3.2.5.2) shows that the difference between all the forecasts until 2020 (Scenario B) is less than 2%, this being the evidence that the TSOs forecasts are very reliable and stable when it comes to hydro power.



F 3.2.5.2 – Comparison of total HPP generation capacity between SO&AF 2013 and SO&AF 2014; Scenarios B and EU2020; January 7 p.m. [GW]

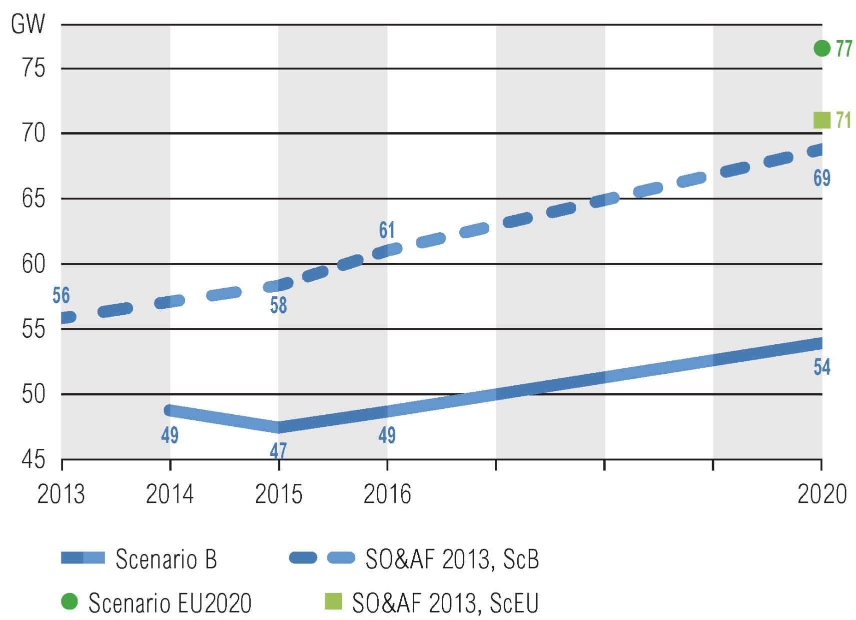
Figure 3.2.5.3 shows the evolution of installed capacity of both RES hydro power plants and non-RES hydro power plants in the different Scenarios. Today, 24% of the total hydro capacity is classified as non-RES hydro, while 76 % is RES-hydro. Towards 2030, it is expected that the relative share will move in the direction of more non-RES. This is due to the need for more flexibility in the power system, and therefore a need to develop hydro pump stations. In 2030 and Vision 4, 34% of the total hydro is expected to be non-RES hydro, while 66% is expected to be RES-hydro.



F. 3.2.5.3 – ENTSO-E non-RES HPP generation capacity forecast; all scenarios; January 7 p.m. [GW]

The expected growth of non-RES hydro is also shown in Figure 3.2.5.4. This figure also shows a comparison of the development of non-RES HPP generation capacity between SO&AF 2013 and SO&AF 2014.

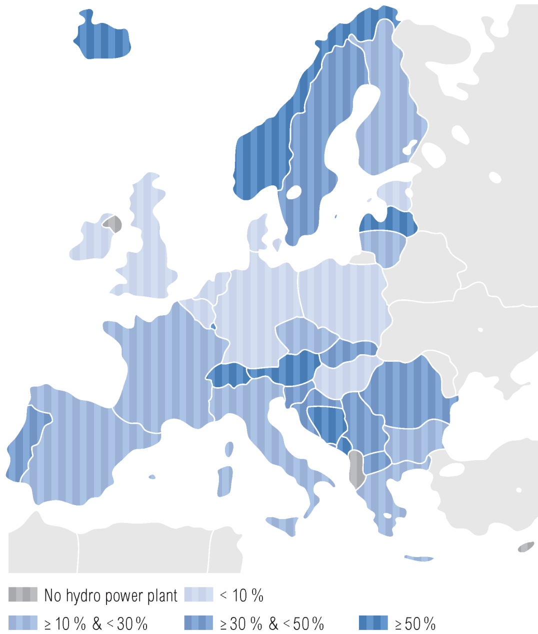
For the avoidance of doubt, it should be taken into account that the difference between 2013 and 2014 is largely related to a different classification made up by TSO between non-RES and RES hydro power.



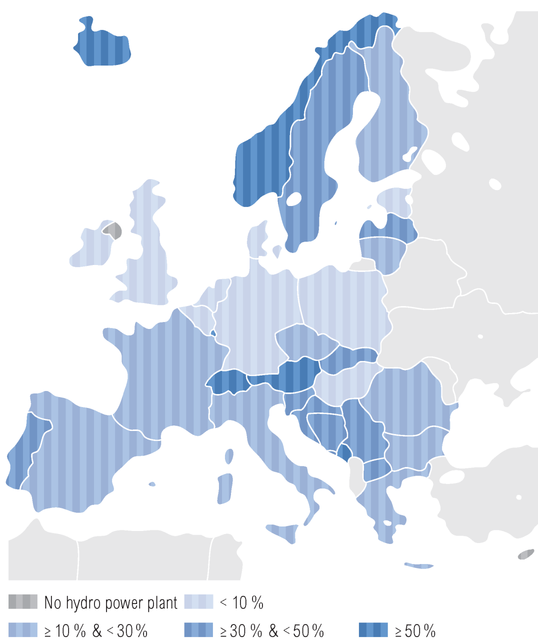
F 3.2.5.4 – Comparison of non-RES HPP generation capacity between SO&AF 2013 and SO&AF 2014; Scenarios B and EU2020; January 7 p.m. [GW]

Scenarios A, B

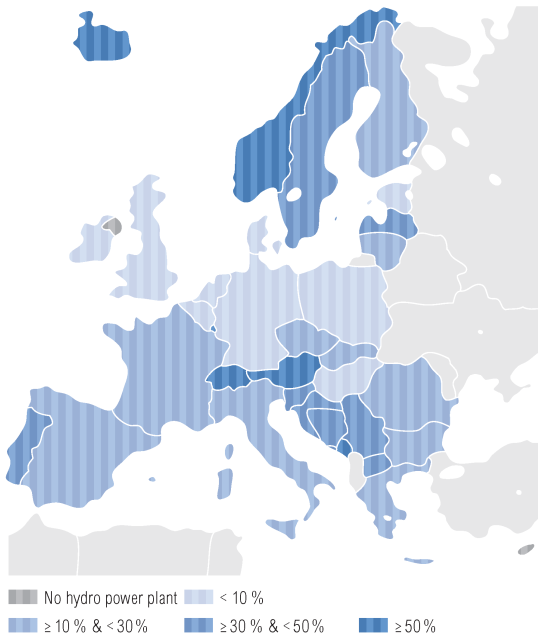
The share of total hydro (RES HPP + non-RES HPP) installed capacity as part of net generation capacity is shown for each country in Figure 3.2.5.5 (Scenario B). The figure depicts that the highest share in Scenario B in 2025 is expected to be in Norway (92%), followed by Switzerland (77%), Iceland (68%), Luxembourg (66%), Montenegro (59%), and Austria (55%).



F. 3.2.5.5 – Total HPP installed capacity as part of NGC per country in 2014; Scenario B; January 7 p.m.



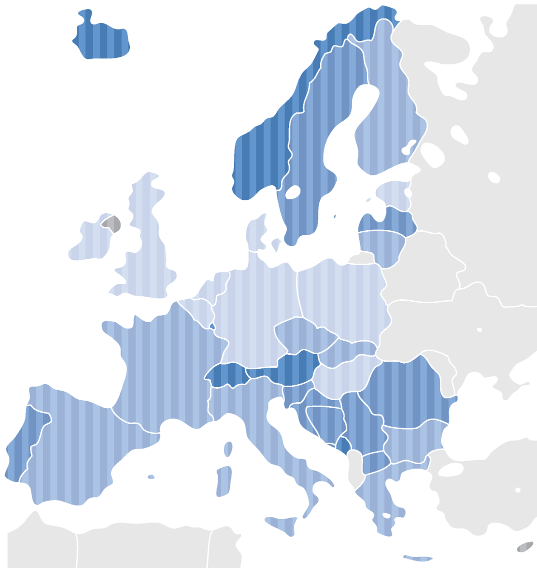
F. 3.2.5.6 – Total HPP installed capacity as part of NGC per country in 2020; Scenario B; January 7 p.m.



F. 3.2.5.7 – Total HPP installed capacity as part of NGC per country in 2025; Scenario B; January 7 p.m.

Scenario EU 2020

In Figure 3.2.5.8, the share of total hydro (RES HPP + non-RES HPP) installed capacity as part of net generation capacity is shown for each country for Scenario EU 2020.



F. 3.2.5.8 – Total HPP installed capacity as part of NGC per country in 2020; Scenario EU2020; January 7 p.m.

Scenario Vision 1 and Vision 4

Table 3.2.5.1 shows the difference of hydro generation capacity in Vision 4, compared to Vision 1. As shown in the table, the total hydro capacity is 14% higher in Vision 4 than in Vision 1. The non-RES hydro in particular (pump stations etc.) is higher for Vision 4: under the assumptions for ñgreen revolutionò, the system need for flexible generation is higher. Furthermore, the guidelines for the 2030 Visions indicate that decentralised storage potential could be entered through an increase of the daily pure storage capacity.

	Vision 4 to Vision 1	Total hydro	non-RES hydro	RES hydro
January 7 p.m.	[GW]	35	26	9
	[%]	14.45%	37.30%	5.24%
July 11 a.m.	[GW]	35	26	9
	[%]	14.42%	37.27%	5.25%

T 3.2.5.1 - Difference of ENTSO-E HPP generation capacity in Vision 4 with relation to Vision 1

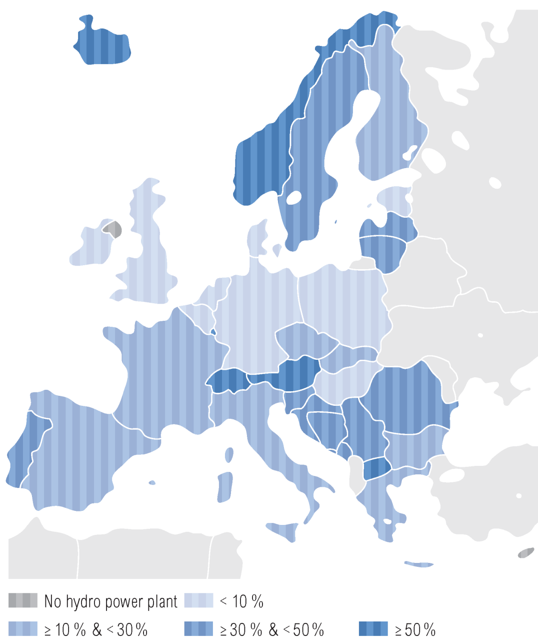
	Vision 4 to Vision 1 as part of NGC in Scenario B 2014	Total hydro	non-RES hydro	RES hydro
January 7 p.m.	[%]	3.48%	2.58%	0.90%

July 11 a.m.	**[%]**	3.45%	2.55%	0.89%

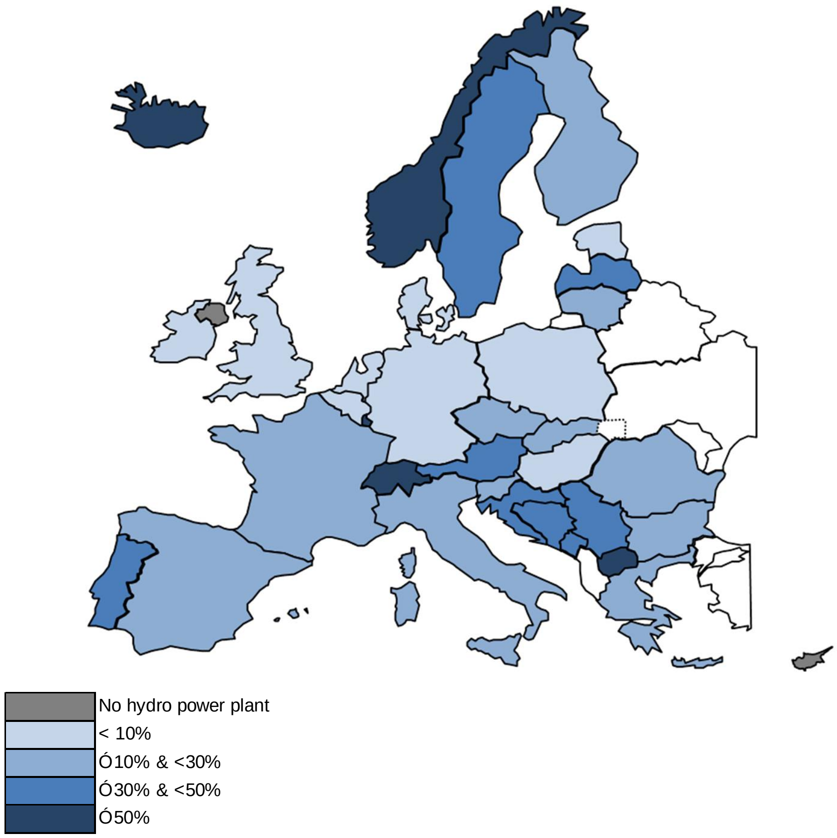
T 3.2.5.2 - Differences of ENTSO-E HPP generation capacity in Vision 4 with relation to Vision 1 as part of total NGC

Table 3.2.5.2 shows the difference of hydro generation capacity as part of net generation capacity in Vision 4 in relation to Vision 1. As shown in the table, the total hydro capacity as part of net generation capacity is 3% higher in Vision 4 than in Vision 1.

Figures 3.2.5.9 and 3.2.5.10 show the share of total hydro (RES HPP + non-RES HPP) installed capacity as part of net generation capacity for each country, for Vision 1 and Vision 4 respectively. Similar to the other (2020) Scenarios, the figures show that the highest hydro-share is expected to be in Norway (90% and 81%) and Switzerland (82% and 65%), followed by Iceland, Luxembourg, Austria and Macedonia with more than 50 % NGC in HPP.



F. 3.2.5.9 – Total HPP installed capacity as part of NGC per country in 2030; Vision 1; January 7 p.m.



F. 3.2.5.10 – Total HPP installed capacity as part of NGC per country in 2030; Vision 4; January 7 p.m.

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3.7 Unavailable Capacity and Reliable Available Capacity

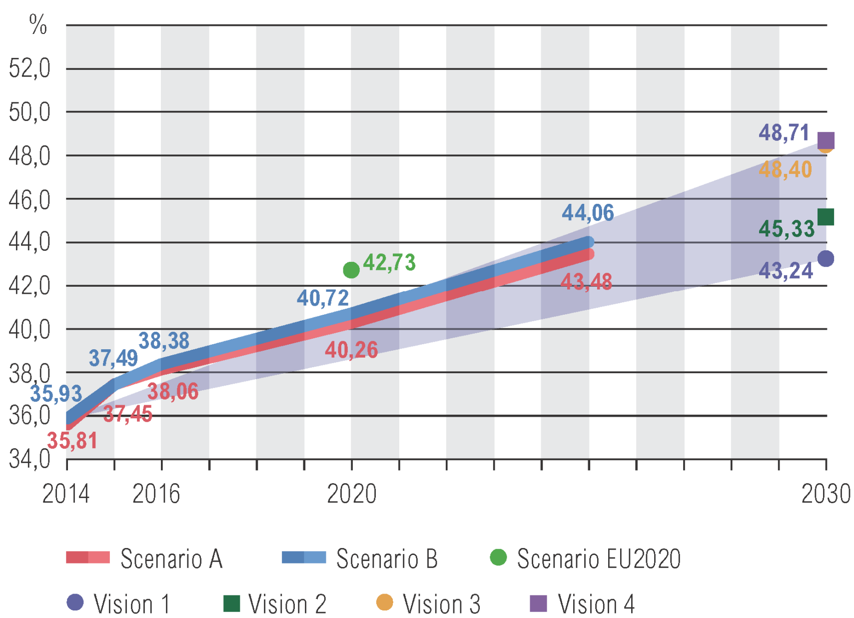
Unavailable Capacity (UC) is made up of four subcategories; aggregating Non-Usable Capacity, Maintenance and Overhauls, Outages and System Services Reserve. In addition to seasonal effects such as maintenance schedules and availability of hydro power, UC is closely linked to variable RES penetration because of the limited availability of certain primary energy sources.

The first two figures assess the evolution of UC as a part of NGC at both winter and summer reference points. For 2020, Scenario EU2020 foresees a slightly more ambitious RES penetration level resulting in an increased percentage of UC.

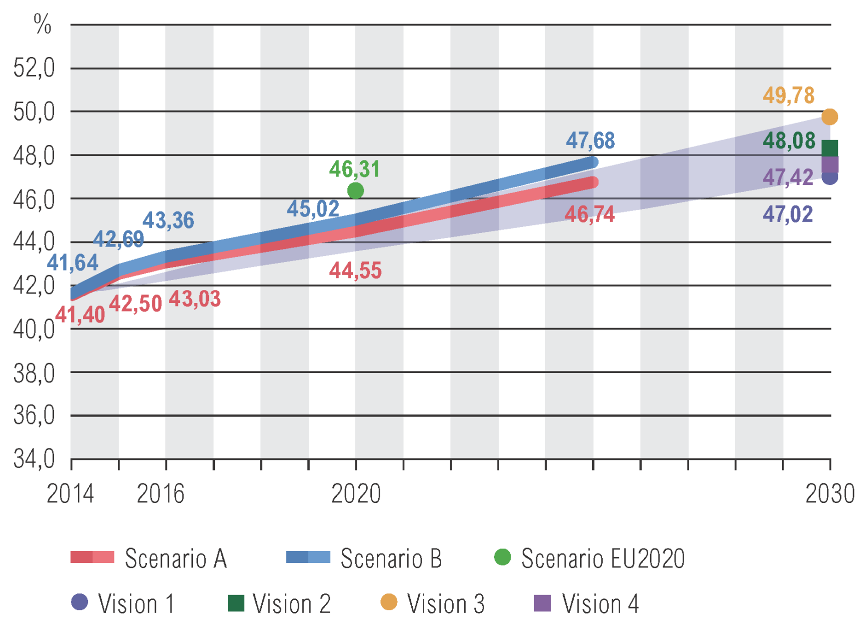
Comparing January data to July data, higher UC ratios can be observed at the summer reference points, which is caused by typical maintenance schedules. It should be noted that the selection of the reference points (11 a.m. in the summer vs. 7 p.m. in the winter, i.e. after sunset) heavily affects the solar photovoltaic part of non-usable capacity. Therefore the average growth rate of UC in the winter is above that in the summer because a relative increase of solar photovoltaic NGC was assumed in the generation mix.

For 2030 visions, the assumptions on non-hydro RES penetration level range from 35% to 52% (as a part of total NGC), while a penetration level of 36% was forecasted by Scenario B for 2025. Therefore some 2030 visions have a decreased level of UC compared to the 2025 forecasts.

In the following part of this chapter, only January figures will be shown, as the trends are very similar for the July reference point.

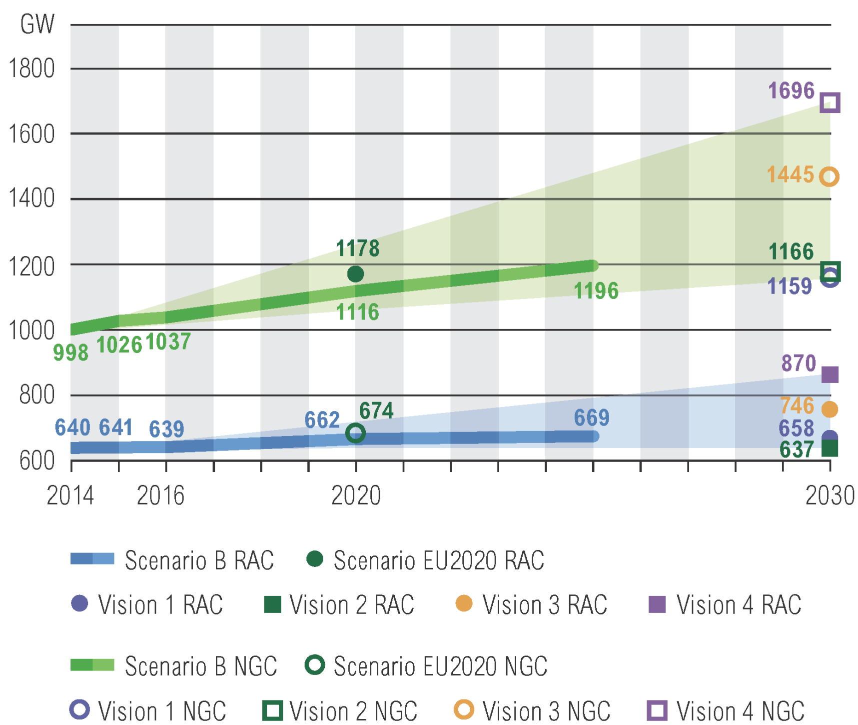


F. 3.3.1 – ENTSO-E UC as a part of NGC, January



F. 3.3.2 – ENTSO-E UC as a part of NGC, July

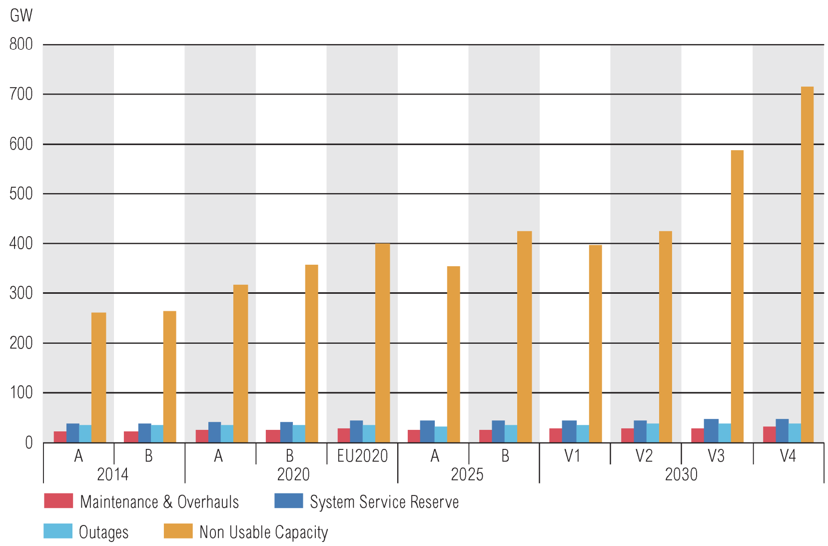
Figure 3.3.3 shows the expected growth of Reliable Available Capacity (RAC) compared to NGC in GW. In line with growing share of UC seen previously, a more moderate increase is expected in RAC than in NGC, suggesting that only a part of new capacity additions can be considered as ‗reliable capacity addition'.

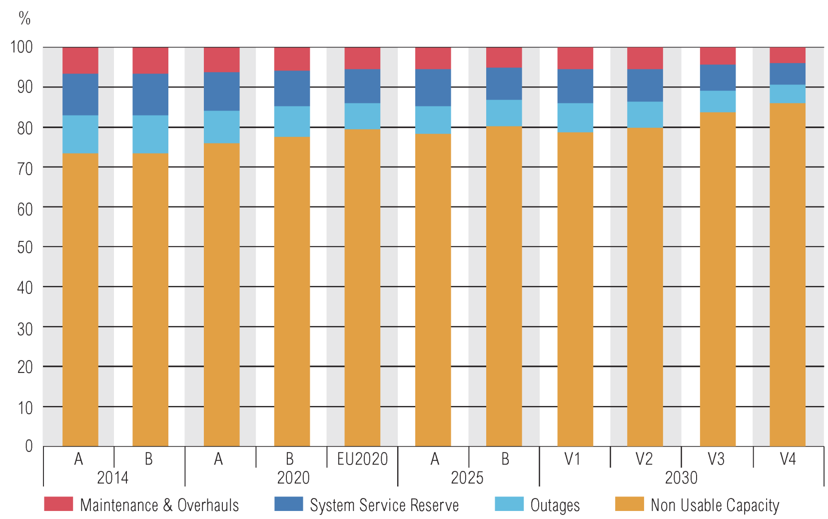


F. 3.3.3 – ENTSO-E NGC & RAC forecast in scenarios B, EU2020 and Visions, January ***[GW]***

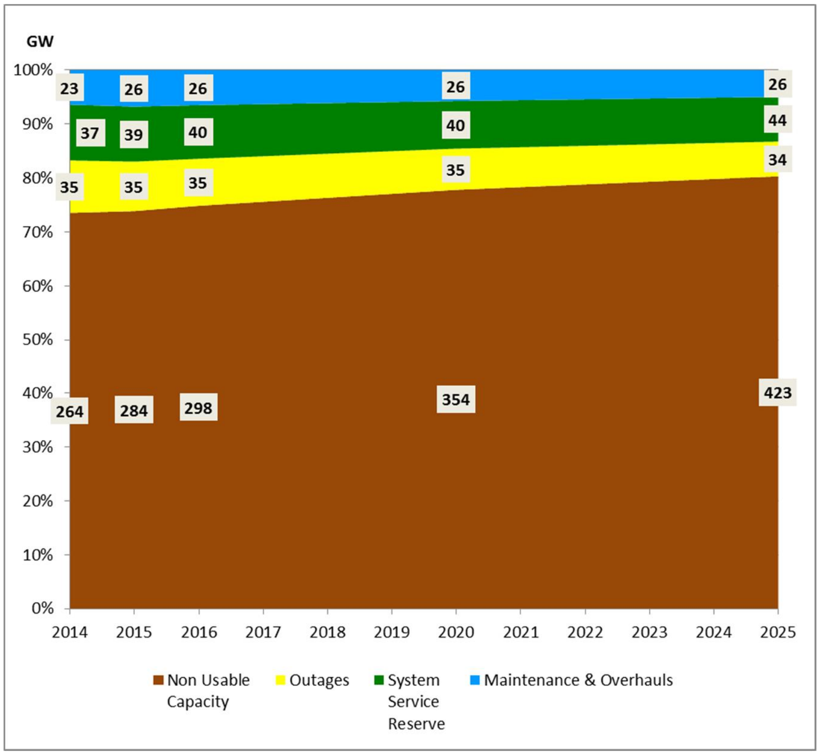
Figure 3.3.4 gives an overview of the components of UC along the different scenarios and visions. The main driver of the growth of unavailable capacity is clearly non-usable capacity. This category encompasses reductions of NGC due to various reasons such as unavailability of primary energy sources (most characteristic of RES generation), transmission constraints or decisions on mothballing taken by power plant operators. Maintenance and Overhauls are expected to increase marginally similarly to the component System Service Reserve. As a consequence of the gradual modernisation of the fleet, nearly constant levels of outages appear in all scenarios and visions.

Figure 3.3.5 shows the changing structure of UC during the forecasted period of Scenario B, while aggregated UC and RAC data for the same period and scenario appears in Figure 3.3.6. 85% of the NGC increase between 2014 and 2025 is considered as UC (corresponding to 168 GW); and only a minor part of 15% (equal to 29 GW) can be taken into account as RAC.

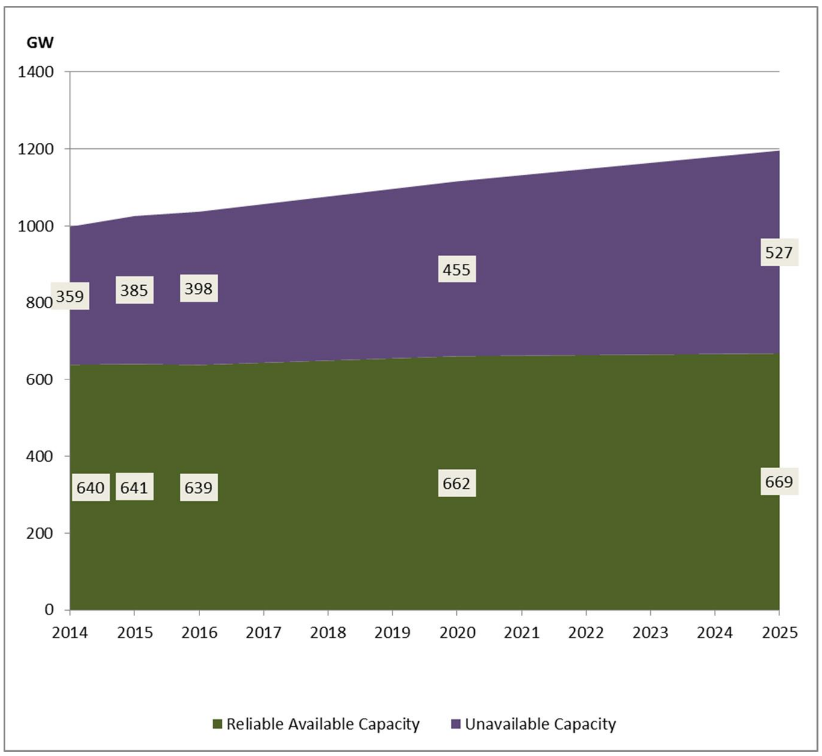




F. 3.3.4 – ENTSO-E UC forecast, January ***[GW]***



F. 3.3.5 – ENTSO-E UC mix, scenario B, January



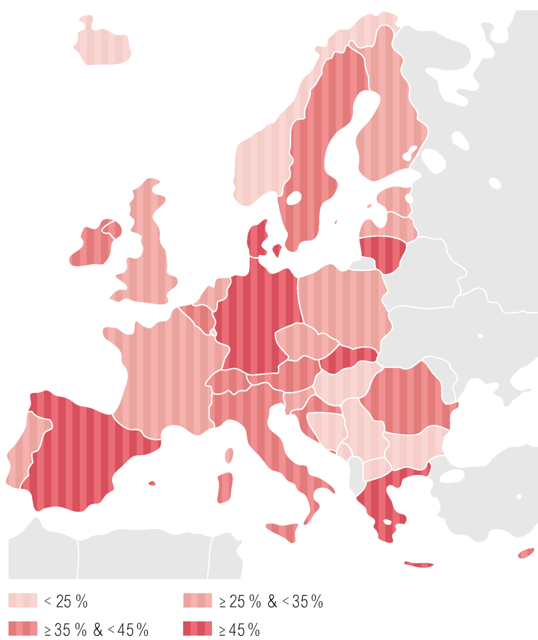
F. 3.3.6 – ENTSO-E UC and RAC forecast, scenario B, January 7 p.m. ***[GW]***

Scenario A, B and EU 2020

When assessing the geographical variation in UC percentages, the following trends can be observed:

- At ENTSO-E level, only a negligible difference can be found in the UC ratios of Scenarios A and B (40.3% vs. 40.7%), since most countries provided similar forecasts for both scenarios in terms of generation mix.
- At the same time, there are large geographical differences in accordance to the generation mix and assumed RES penetration. Rapid-growing renewable generation capacity (especially wind and solar) has a much lower availability factor than other generation types.

Figure 3.3.7 and Figure 3.3.8 compare UC as a part of NGC per country in 2020 for the cases of Scenarios B and EU2020. For Scenario B, values range from 5.6% (Iceland) to 69.47% (Denmark). In addition to Denmark, there are other countries with an UC percentage exceeding 50%: Germany (57.7%), Lithuania (54%, due to mothballed units) and Spain (50.2%). A similar distribution can be observed in Scenarios A and EU2020.



F. 3.3.7 – UC as a part of NGC per country in 2020, Scenario B, January

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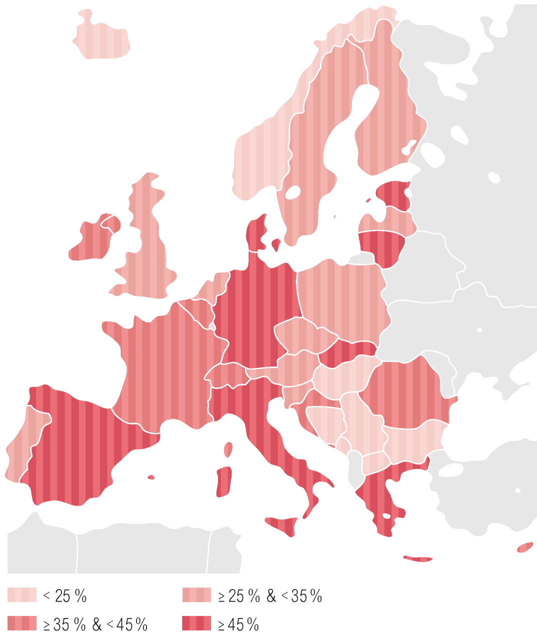
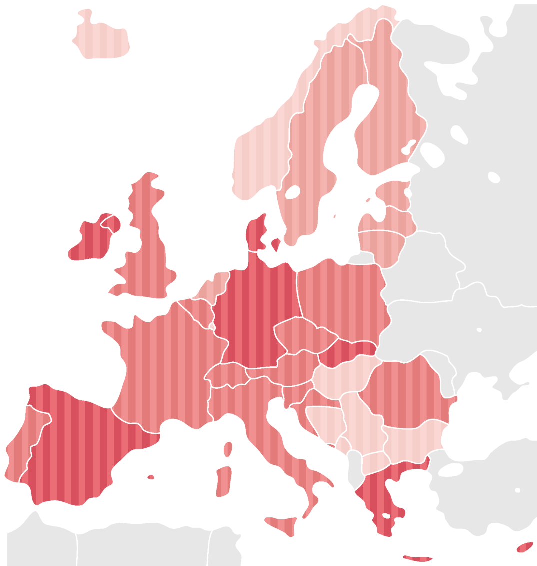


F. 3.3.8 – UC as a part of NGC per country in 2020, Scenario EU 2020, January

Figure 3.3.9 shows the UC ratios expected in 2025 according to Scenario B. The ENTSO-E average of UC can reach 44%, which is 3% higher than the level forecasted for 2025. The projected UC ratios vary between 5.6% and 72.7% (Denmark).

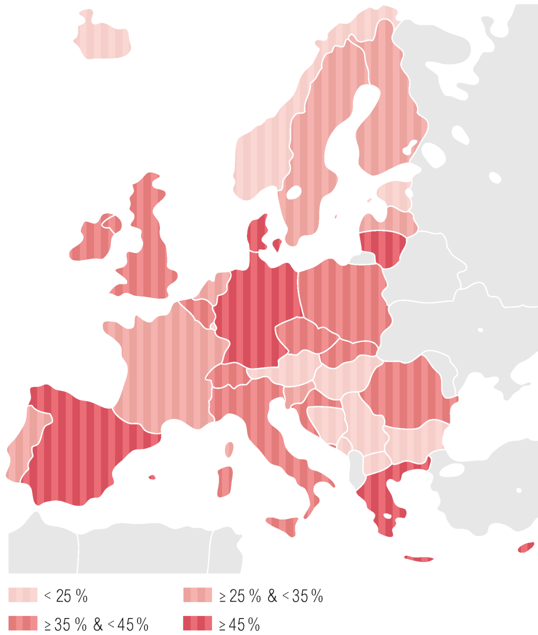


F. 3.3.9 – UC as a part of NGC per country in 2025, Scenario B, January

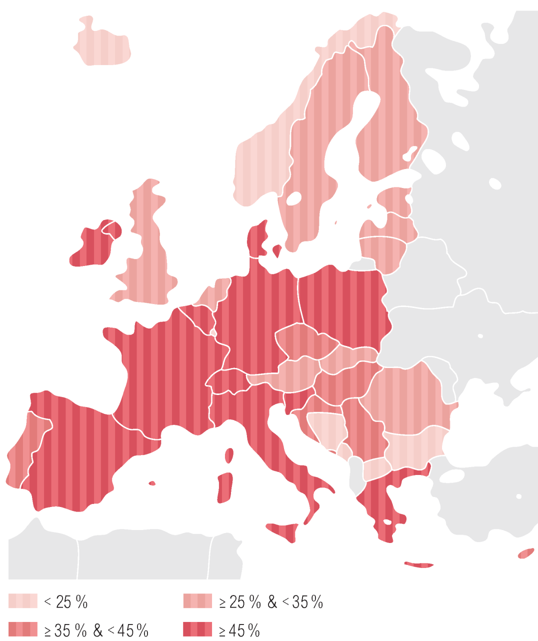
Vision 1 and 4

For 2030, Vision 1 (Figure 3.3.10) and Vision 4 (Figure 3.3.11) represent the extreme values (43.2% and 48.7% on average, respectively) for projected UC in accordance with RES penetration assumptions.

In both visions, Denmark has the highest relative UC (67.4% in Vision 1 and 77.2% in Vision 4), closely followed by Germany (65.1% and 70.5%), as well as Spain and Greece (above 50%). The high RES penetration assumptions in Vision 4 are also reflected in elevated Unavailable Capacity ratios.



F. 3.3.10 – UC as a part of NGC per country in 2030, Vision 1, January



F. 3.3.11 – UC as a part of NGC per country in 2030, Vision 4, January

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4. Adequacy Forecast

4.1 ENTSO-E wide analysis

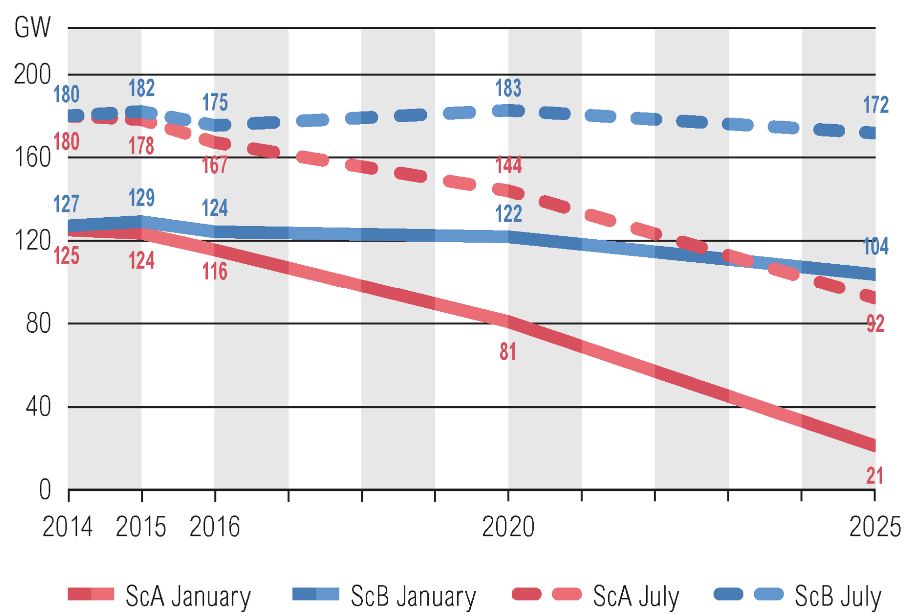
Remaining Capacity & Adequacy Reference Margin

Scenario A and Scenario B

Remaining Capacity (RC) shows different trends in Scenario A and Scenario B according to the different assumptions made for each of them. The expected Remaining Capacity (RC) values for the whole forecast period are presented in Table 4.1.1 and Figure 4.1.1.

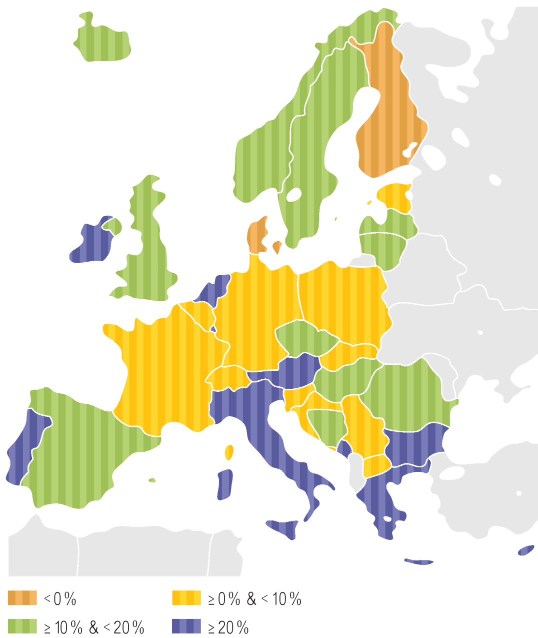
RC [GW]	Scenario	2014	2015	2016	2020	2025
January 7 p.m.	A	125	124	116	81	21
	B	127	129	124	122	104
July 11 a.m.	A	180	178	167	144	92
	B	180	182	175	183	172

T 4.1.1 – ENTSO-E RC for Scenarios A&B

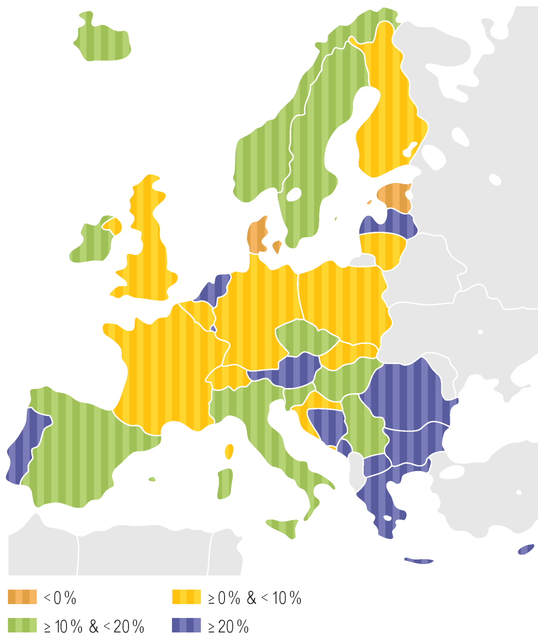


F 4.1.1 – ENTSO-E RC forecast, Scenarios A&B [GW]

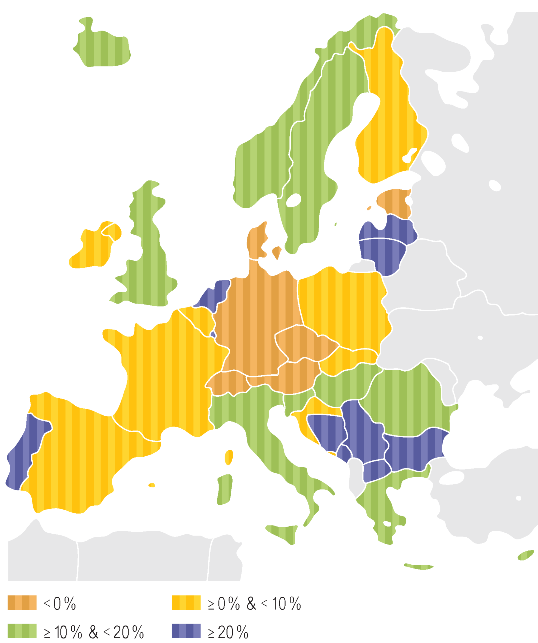
RC at an ENTSO-E level is expected to be positive for both Scenarios at both reference points during the entire forecast period. However, there is a continuous decrease in the level of RC in Scenario A until the end of the forecast period (2025). For Scenario B, a decrease in RC can be observed between the years 2015 and 2016 and lasts until 2025 at the winter reference point. In Scenario A, 104 GW of firm generation capacity is missing in 2025, if the RC level of 2014 is judged as an adequate benchmark. Figures 4.1.2, 4.1.3 and 4.1.4 show RC as a part of NGC per country (Scenario B) in 2015, 2020 and 2025, respectively.



F 4.1.2 – RC as a part of NGC per country in January 2015, Scenario B



F 4.1.3 – RC as a part of NGC per country in January 2020, Scenario B



F 4.1.4 – RC as a part of NGC per country in January 2025, Scenario B

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In the majority of ENTSO-E countries, the share of RC in the total NGC is higher than the average ENTSO-E value in 2015.

The highest levels of RC as part of NGC in 2015 are in Luxembourg (39 %) and Montenegro (34 %), followed by Bulgaria (31 %) and the Netherlands (30 %). The only countries foreseeing a slightly negative Remaining Capacity are Denmark (-11 %) and Finland (-5 %). In 2020, Montenegro (42 %) and Luxembourg (39 %) are followed by Bosnia- Herzegovina (33 %) and Portugal (31 %) expecting the highest share of RC in NGC. On the other hand, Denmark (-20 %) and Estonia (-3 %) show negative values. In 2025, Latvia (46 %), followed by Bosnia and Herzegovina (34 %) and Lithuania (33 %) are on the top of RC as part of NGC, while Denmark (- 23 %) and Estonia (- 8 %) show the lower negative values.

Table 4.1.2 shows the values of RC-ARM for Scenarios A and B for both reference points. The generation adequacy within the whole ENTSO-E system in Scenario B is expected to be maintained during the entire forecast period 2014 ï 2025 in most of the situations, however with considerably declining margins, especially in the beginning of the next decade (2020-2025). In Scenario A, generation adequacy is expected to remain stable until 2016 at the winter reference point (Figures 4.1.5 and 4.1.6). After this year, it seems necessary to install some new generating units in order to deal with unexpected load variations within the ENTSO-E system. The amount of additional reliable generating capacity (in order to maintain present margins) is 47 GW by 2020 and reaches over 100 GW by 2025. Scenario B retains decreasing but positive values during the whole period at both reference points.

ENTSO-E			2014	2015	2016	2020	2025
January	ScA	MaPL	35	39	40	35	37
		Spare Cap.	50	51	51	52	52
		ARM	**85**	**90**	**90**	**87**	**88**
		RC-ARM	**40**	**34**	**25**	**-6**	**-67**
	ScB	MaPL	35	39	40	35	37
		Spare Cap.	50	51	52	56	60
		ARM	**85**	**90**	**92**	**91**	**96**
		RC-ARM	**42**	**39**	**33**	**31**	**7**
July	ScA	MaPL	44	48	45	49	47
		Spare Cap.	50	51	51	52	52
		ARM	**94**	**99**	**96**	**101**	**99**
		RC-ARM	**86**	**79**	**71**	**43**	**-7**
	ScB	MaPL	44	48	46	49	52
		Spare Cap.	50	51	52	56	60
		ARM	**95**	**100**	**98**	**105**	**112**
		RC-ARM	**85**	**82**	**78**	**78**	**60**

T 4.1.2 – ENTSO-E RC and ARM comparison for Scenarios A&B [GW]

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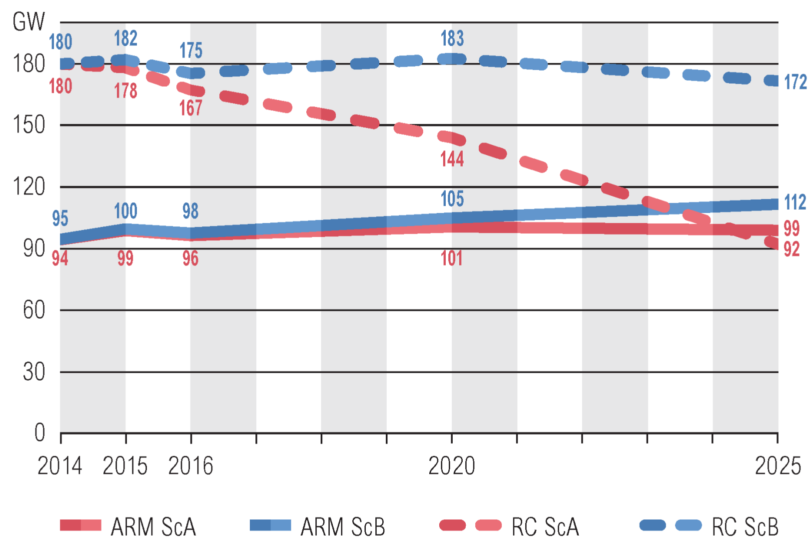
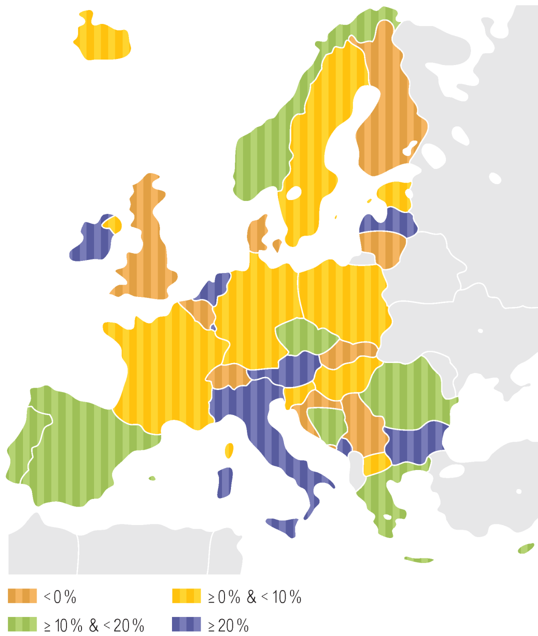
F 4.1.5 – ENTSO-E RC and ARM comparison, Scenarios A&B, January 7 p.m.



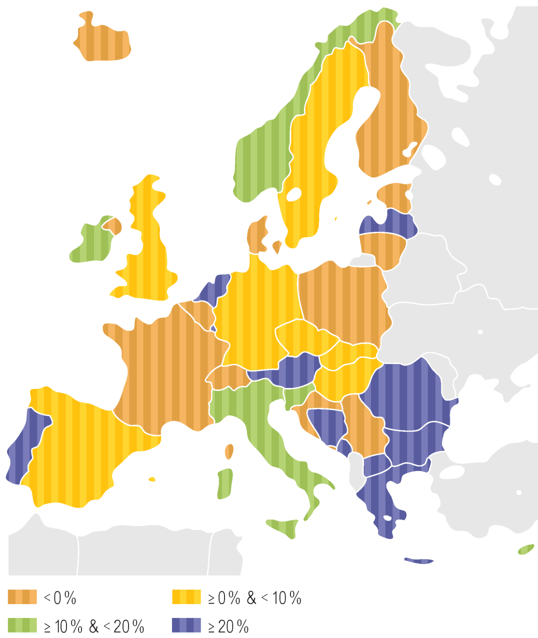
F 4.1.6 – ENTSO-*E RC and ARM comparison, Scenarios A&B, July 11 a.m.*

The situation in each country is presented in Figures 4.1.7 and 4.1.8 below. In most countries, the difference between RC and ARM is positive.

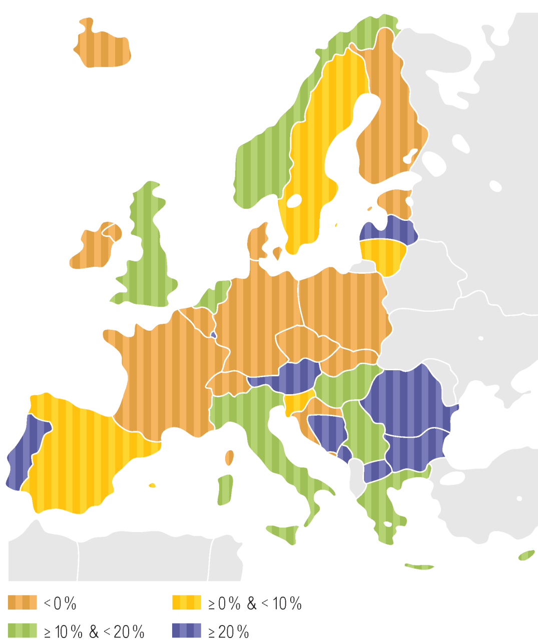


F 4.1.7 – Remaining Capacity minus Adequacy Reference Margin as a part of Reliably Available Capacity per country, Scenario B, January 2015, 7 p.m.[4]

[4] The Adequacy Reference Margin includes Margin Against Seasonal Peak Load. As seasonal peak load does not occur simultaneously, this map shall not be understood as a European-level assessment of adequacy.



F 4.1.8 – Remaining Capacity minus Adequacy Reference Margin as a part of Reliably Available Capacity per country, Scenario B, January 2020, 7 p.m.



F 4.1.9 – Remaining Capacity minus Adequacy Reference Margin as a part of Reliably Available Capacity per country, Scenario B, January 2025, 7 p.m.

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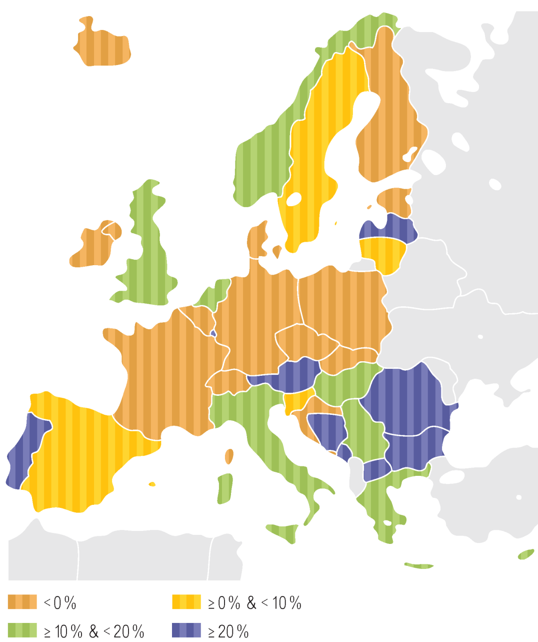
In 2015, the countries with the highest share of RC-ARM in their national RAC are Luxemburg (39 %), Bulgaria (27 %) and the Netherlands (27 %), followed by Latvia (26 %) and Montenegro (26 %). In 2020, Luxembourg (39 %), Montenegro (37 %), FYR of Macedonia (35 %) and Latvia (32 %) have the highest values, while for 2025 Montenegro (36 %), Luxembourg (34 %) and Latvia (34 %) lead the list of the countries with the highest values of RC-ARM as part of RAC.

Denmark has the lowest (and steadily decreasing RC-ARM margin with values of -37%, -79% and -99% for 2015, 2020 and 2025, respectively. The other countries with the lowest share in 2015 are Finland (- 20 %), Belgium (- 14 %), Serbia (-14 %) and Croatia (-13 %), in 2020 Lithuania (-45 %), Belgium (-18 %) and Estonia (-13 %). Finally, Denmark is followed by Estonia (-35 %), Switzerland (-22 %) and Czech Republic (-22 %) in 2025.

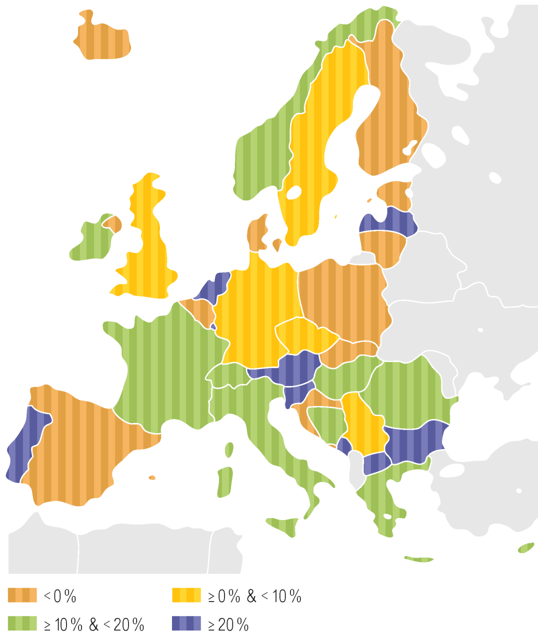
Scenario EU 2020

RC as a part of NGC per country in 2020 is shown in Figure 4.1.10 below. In the majority of the countries, the share of RC in total NGC is higher than the average ENTSO-E value, remaining positive in all countries with the exception of Estonia, Denmark and Lithuania.
The highest levels of RC as part of NGC in 2020 are those in Luxembourg (48 %), Bulgaria (35 %), Montenegro (34 %) and Portugal (31 %) ; the lowest values are expected in Estonia (- 10 %), Denmark (- 4 %), Lithuania (-1 %), as well as Croatia, Germany, Finland, Belgium, Northern Ireland and Slovak Republic (positive values below 5 %).



F 4.1.10 – RC as a part of NGC per country – Scenario EU 2020, reference point January

As for RC-ARM expressed as a percentage of Reliable Available Capacity, the highest value also corresponds to Luxembourg (48 %), followed by FYR of Macedonia (37 %) as well as Bulgaria, Portugal and Latvia with values between 30 % and 32 %. The lowest values occur in Estonia (- 61 %), Lithuania (- 50 %), as well as Belgium, Denmark, Croatia and Northern Ireland (between - 18 % and - 11 %).



F 4.1.11 – Remaining Capacity minus Adequacy Reference Margin as a part of Reliably Available Capacity per country, Scenario EU 2020, reference point January

4.2 Regional analysis

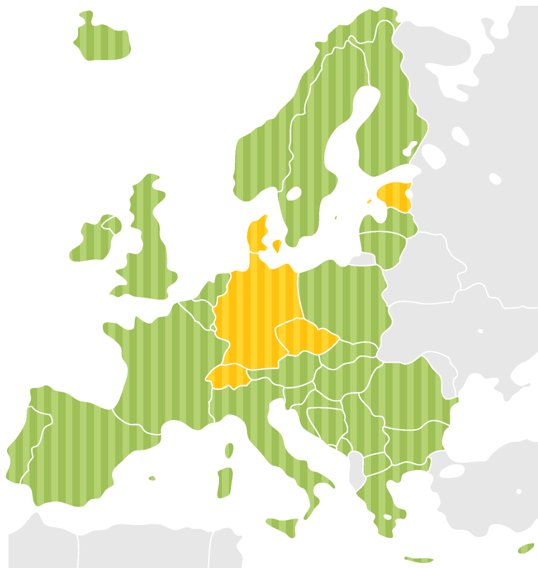


Figure 4.2.1: Remaining Capacity minus Adequacy Reference Margin; Scenario B; January 2025

The target of regional analysis is to take into account groups of countries expected to simultaneously cover part of their load from imports and detect if problems can arise on a pan-European scale due to a lack of available capacity. No market simulation or grid model simulation is taken into account.

The problem is modelled as a linear optimization of covering the needs of importing countries from the ones with excess capacity, taking into account the boundary condition of total simultaneous imports and exports should be lower or equal to the given limits.

According to the results, the block of Denmark, Germany, Czech Republic and Switzerland may simultaneously require import in the winter period under the assumptions of the Scenario B in 2025. Import from all countries directly connected to the aforementioned group is foreseen, with Germany possibly requiring the most import. The total of the Remaining Capacity in the four countries is -10.3 GW, whilst there is ample import capacity available on the external borders of the group to cover this amount.

No significant regions or groups of countries are identified as requiring simultaneous imports for 2020 or for the summer reference point of 2025.

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5. Conclusions

The SO&AF 2014 is prepared based on input data provided by TSOs (national data correspondents) from ENTSO-E member countries during January and February 2014. It covers the time period from 2014 to 2030 (depending on the Scenario). Assessment and evaluations have been prepared for three Scenarios until 2025:

- Scenario EU 2020 (based on NREAPs),
- Scenario A (ñConservative Scenarioò) and
- Scenario B (ñBest Estimate Scenarioò) ;

, as well as four Visions for 2030.

Details and underlying assumptions of the different Scenarios can be found in the Methodology section of the report.

Load is expected to increase throughout the entire forecast period in each scenario. The best estimate of TSOs foresees an approximate annual average growth of 0.9 % between 2014 and 2025, slower in the initial part of the assessed period and picking up from the end of present decade. The different assumptions for 2030 Visions result in a possible annual load growth rate in the next decade ranging from 0 % to 1.3 %. For the entire ENTSO-E area, the expected total load growth in Scenario B is approximately 30 GW until 2020 and a further 25 GW by 2025 (compared to the 2014 expected values). Montenegro and Slovenia expect the fastest load increase.

The total ENTSO-E Net Generating Capacity (NGC) is also increasing in each scenario. Of all primary energy sources, the biggest development is reported for renewable energy sources (including renewable hydro generation). The foreseen increase in RES capacity (regardless of the Scenario) could be expected, and is a confirmation of continuous investor interest, also promoted by the existing support schemes on a national or European level. Wind and solar generation are the main drivers of the expected RES installed capacity growth, and within wind, offshore installations may increase their share in the 2020s. The total growth of RES capacity between 2014 and 2025 in Scenario B is 230 GW, which corresponds to a 60 % increase (out of which 130 GW is wind, 60 GW is solar, 17 GW is biomass, and 19 GW is hydro).

An overall decline in fossil installed generation capacity is forecasted for the coming decade. Within the main category however, gas-fired units are expected to increase their capacity in absolute values as well. This increase is continuous over the assessed period, regardless of the Scenario (except Scenario A after 2016) and despite. Cyprus is expected to maintain the highest ratio of installed capacity of fossil power units as a part of NGC, followed by the Poland and Hungary. Lignite, hard coal and oil power plant capacities are decreasing in each scenario.

The report also notes that the generation adequacy is expected to be maintained during the entire forecast period (in Scenario B and Scenario EU20, and in each reference point), however with a considerably decreasing margin level in the 2020s. It must be noted however, that under conservative Scenario A, at the winter reference points at and beyond 2020, the level of adequacy becomes negative, underlining the need for further investments compared to what is confirmed today. When these results are compared to those of the previous SO&AF 2013, a significant decrease in adequacy levels on a mid-term time horizon is observed.

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6. National adequacy assessment

6.1 Austria

Generating Capacity

Calculations for Scenario B (and partly for Scenario EU 2020) are based on data collected from market participants for the preparation of the ñAPG Masterplan 2030ò and the ñAustrian Network Development Plan 2013ò. Due to a new legislative framework for renewables, a sharp increase in wind and solar power plants is expected.

Unavailable Capacity

100 % of wind and solar power plants are treated as unavailable capacity. A part of hydro capacity is also considered as unavailable due to operating and environmental constraints. Fossil fuels unavailability (maintenance and outages) are calculated from historical average data.

Load

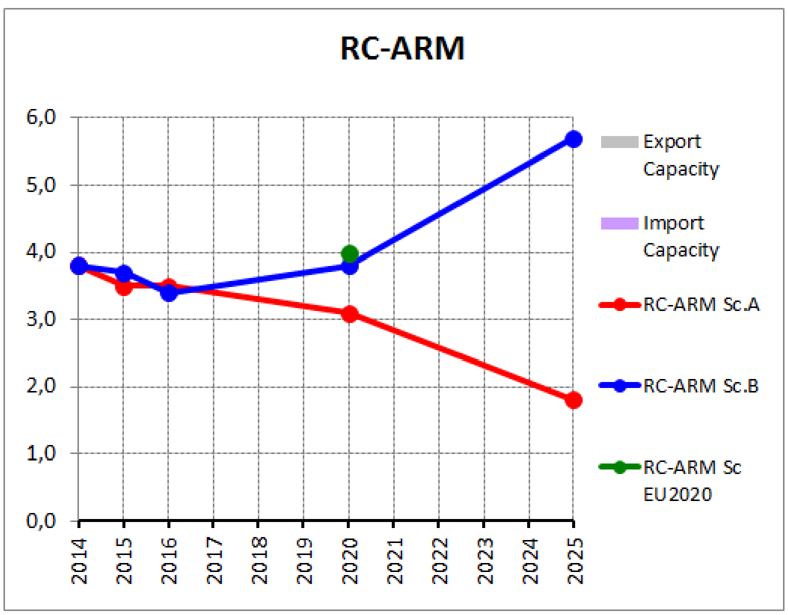
The forecast of load in Scenarios A and B is based on the load forecast for the reference scenario of the NREAP 2010. For Scenario EU 2020 the efficiency scenario of NREAP 2010 is taken into account.

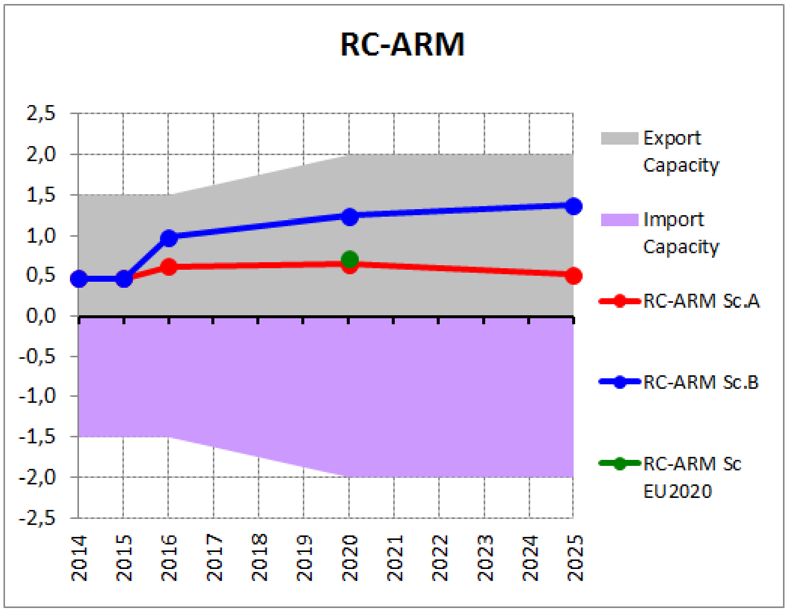
Generation Adequacy

For all scenarios sufficient RC-ARM is available in the Austrian electricity system.

Interconnection Capacity

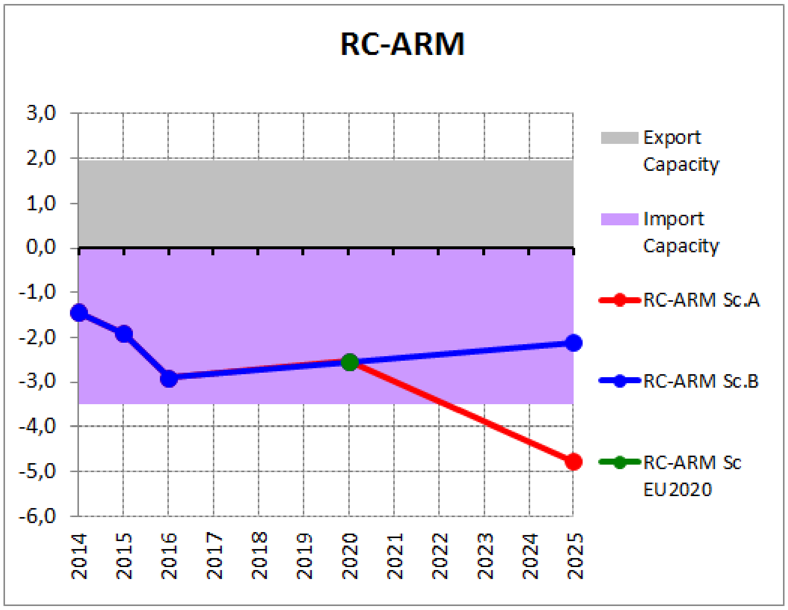
The grid projects defined in the ñAustrian Network Development Plan 2013ò and in the ñAPG Masterplan 2030ò are an essential prerequisite to integrate the new generating capacities and to keep security of supply on a high level.





6.2 Bosnia and Herzegovina

6.3 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 which are supplemented by estimates to ensure 100 % representativeness.

Generating Capacity

The renewable generation in all scenarios in 2020 respects the renewable energy level in TWh announced in the Belgian NREAP, but deviates from the installed capacities. The deviation results from taking into account regional objectives regarding the installed generation capacity of wind, renewable hydro and solar, as well as the current installed generation capacities. The RES installed capacities in 2030 Vision 1 are ï as requested by ENTSO-E methodology ï the same as those used for Scenario EU2020. The RES installed capacities in 2030 Vision 3 are constructed by prolongation of the growth rate between 2020 and 2019 until 2030 for onshore wind farms, biomass plants and photovoltaic panels. The installed capacity of offshore wind is set at the maximum offshore capacity taken into consideration in the NSCOGI study for Belgium for 2030. For run-of-river generation it is assumed that the maximum potential has already been obtained in 2020.

The implementation of the nuclear phase-out is taken into consideration in all scenarios, including the revision which has been decided on by the federal Belgian government on 4th of July 2012 postponing the phase out of one unit by 10 years (1 GW). By the end of 2025 all nuclear units will be phased out.

For the horizon 2014-2016 it is assumed that no new thermal units will be commissioned and that no existing large thermal units will be decommissioned or mothballed as a consequence of the strategic reserve mechanism being set up in Belgium. On top of this a tender for 800MW of new gas power plants is assumed for the horizon 2020. For the horizon 2025 (year of the nuclear phase out), new units are commissioned based on the assumption that generation adequacy at normalized peak load should be maintained for Scenario B. The commissioned thermal units are assumed to be gas power plants. For the Scenario A no new units are commissioned for 2025, since this is too far in the future to be sure projects. This leads to the fact that Belgium is not adequate in this scenario for 2025.

Unavailable Capacity

Unavailable capacity will increase over the period 2014 ï 2030, mainly due to a rise in the number of wind farms, biomass power plants, photovoltaic panels and CHPs included in the net generating capacity, for which the average unavailability is considered. This trend will lead to an increase in the volume of non-usable capacity.

Load

The proposed ENTSO-E load methodology is applied.

Elia has numerous load-shedding contracts with industrial customers. These contracts are part of the system services reserve and increase from a contracted volume of 261 MW in 2013 to 300 MW in 2015. No estimation of the system services needed in 2030 is available, meaning that the level is assumed to remain the same in 2030 as in 2020.

In the framework of the strategic reserve mechanism demand can play an important role. Since this is a new product, it is difficult to predict what will be the potential for the future. Therefore, this product is not yet taken into account.

Generation Adequacy

The spare capacity is elaborated on using the proposed ENTSO-E methodology for an individual country. It is set at 5 % of Net Generating Capacity. However, since the non-usable capacity of wind is determined using the average historical output profile of wind during January, an additional capacity is taken into account reflecting the difference between this average availability and availability of only 10 % for the installed wind capacity.

The normalized winter and summer peak load is obtained by aggregating the forecasts of the TSO of individual loads at the different nodes of the transmission grid for the different years.

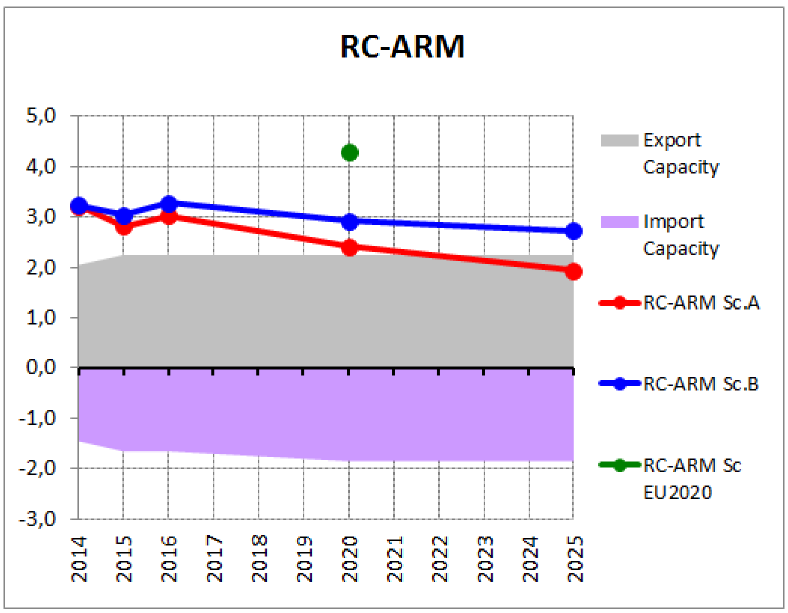
The margin against peak load does not reflect a peak load which occurs under severe temperature conditions.

Interconnection Capacity

In this analysis, the simultaneous import and export capacity is the average simultaneous import and export capacity for the winter 2012/2013 [i.e. 3500 MW]. The potential import and export capacity increase associated to the planned interconnection projects is currently under study and has not been included in this analysis.

As for the market risk, the hypothesis that 3500MW are available in the surrounding countries, should be validated by an analysis of the CWE production park. Without that kind of study, Elia has insufficient indication that increasing the import capacity above the 3500MW, and thus increasing the structural dependency of production from the neighboring countries, is reasonable.

6.4 Bulgaria



6.5 Croatia

Net Generating Capacity

The following assumptions have been made to build Scenario EU 2020:

Data about the planned installed capacity of hydro power plants and other renewable energy sources are taken from the National Renewable Energy Action Plan (NREAP) which was adopted in October 2013:

- Till 2020 installation of a new and revitalization of existing hydropower plants is planned, which would increase the installed capacity of HPP for about 400 MW.
- In the year 2020 the installed capacity of wind power plants is planned to be 400 MW.
- In the year 2020 installed capacity of the other RES is planned to be 200 MW (100 MW of biomass + 100 MW of the other RES).

Data about the planned installed capacity of power plants using fossil fuels are the same as for A scenario.

The following assumptions have been made to build Scenario B:

- There is great interest from investors to build thermal power plants in Croatia, but most of the projects are currently in the initial phase. For a certain number of thermal units decommissioning is planned which depends largely on the requirements relating to environmental (air) protection. The total installed capacity of TPP for B scenario till 2025 is predicted optimistically.
- Till 2020 installation of a new and revitalization of existing hydropower plants is planned, which would increase the installed capacity of HPP for about 400 MW.
- In the year 2020 the installed capacity of wind power plants is planned to be 700 MW which is more optimistic than it was predicted in National Renewable Energy Action Plan. In the year 2025 the installed capacity of wind power plants is estimated to be 1000 MW.
- In the year 2020 installed capacity of the other RES is planned to be 300 MW (100 MW of biomass + 200 MW of the other RES) which is more optimistic than it was predicted in National Renewable Energy Action Plan.

The following assumptions have been made to build Scenario A:

- The installed capacity of RES is prepared in accordance with NREAP.
- Compared to Scenario B is estimated to lower the installed capacity of TPP of 200 MW in 2020 and 300 MW in 2025.

Visions 1 to 4

The period until 2030 will characterize the increased construction of HPP and other Renewable Energy Sources with the goal of reducing CO_2 emissions.

Unavailable Capacity

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 no usable capacity in old TPP units that will gradually cease operation.

Load

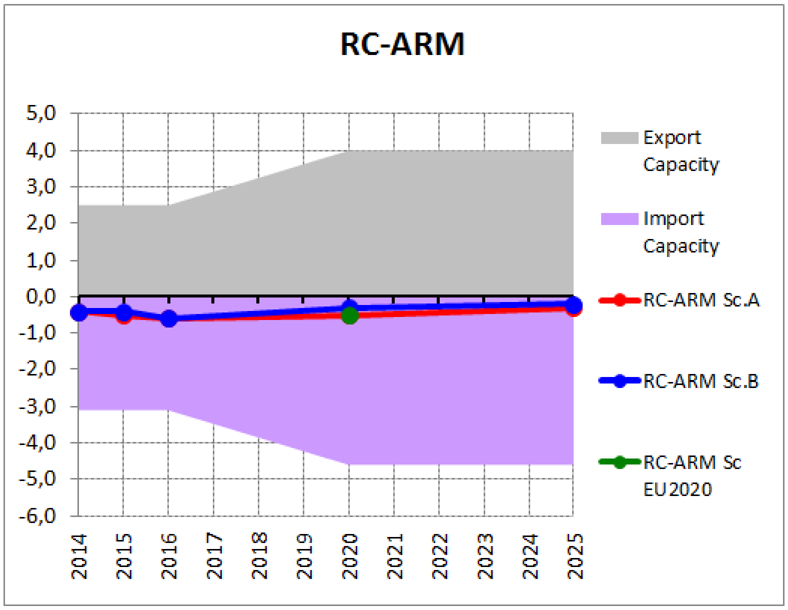
Load forecast has been built taking into account medium and long term projections of economic growth rate. Growth of the load depends directly on the industry development and growth of the household consumption. Significant investments in energy efficiency are expected and that will slow the growth of electricity consumption.

Spare Capacity

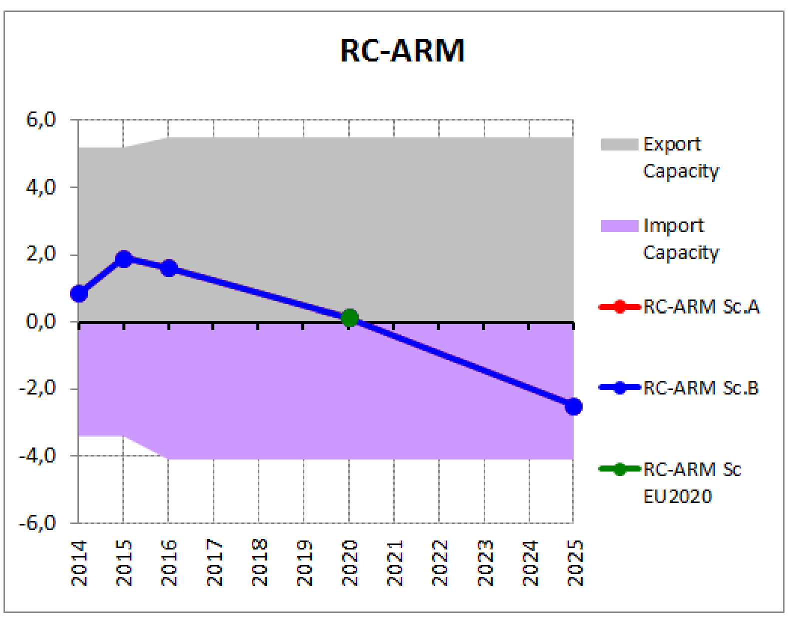
Spare capacity will be in the range of about 5 % of Net Generation Capacity that is from 200 MW in 2013 to expected 300 MW in 2020.

Simultaneous Interconnection Transmission Capacity

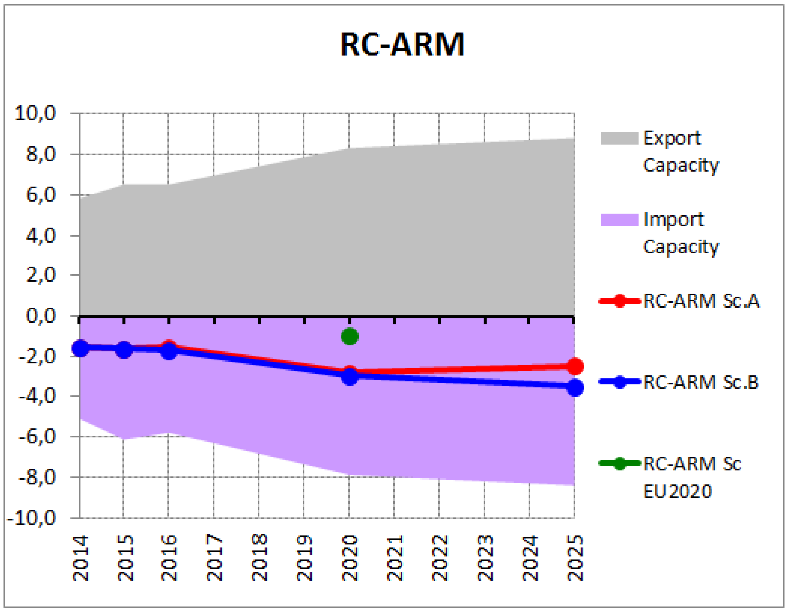
The project of new substation Lika will facilitate the connection of RES. Substation Lika is precondition for new interconnection with Banja Luka in Bosnia and Herzegovina. OHL 400 kV Banja Luka ï Lika will increase the cross-border capacity, support market integration, improve the security of supply and support conventional generation integration.



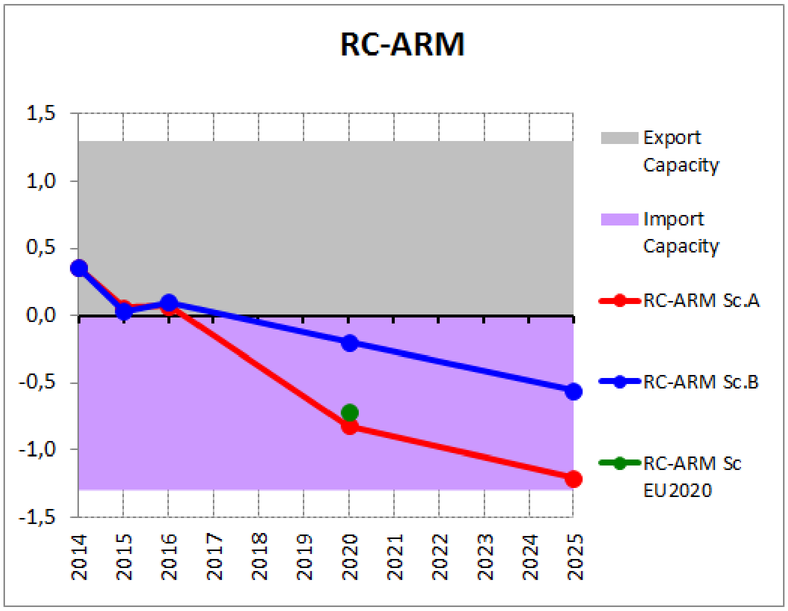
6.6 Czech Republic



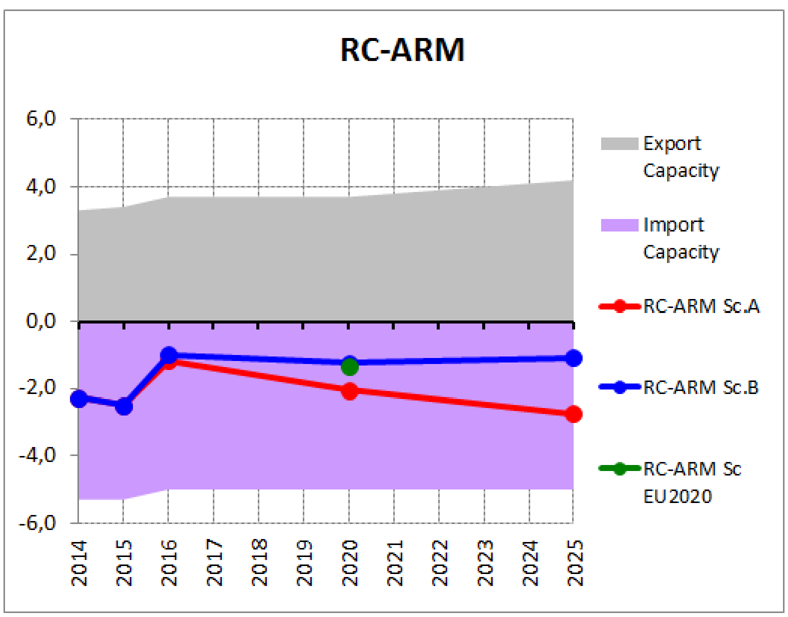
6.7 Denmark



6.8 Estonia



6.9 Finland



6.10 France

2014 – 2025 – Scenario A

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General comments

Should no further investments be secure, security of supply should not be guaranteed by 2016, mostly reflecting the decommissioning of fossil-fired capacities not compatible with new emission regulation by 2016.

Net Generating Capacity

The NGC decreases every year from 2014 to 2025. Main hypotheses explaining this result are the following:

- For thermal units, the implementation of the European directive IED, and the end of special dispensations to the previous directive (LCPD) for some units, will lead to the shutdown of more than 6 GW of hard coal and oil units between 2014 and 2016, if no additional upgrade to norms is done on existing oil units. The only new units considered as sure are 1.6 GW nuclear and 0.5 GW CCGT.
- For the renewable energy sources, the conservative hypothesis is a constant capacity of RES between 2014 and 2025 as RES regulation is under much questioning at European and national scale.

Unavailable Capacity

Based on historical data, 70% of the installed wind capacity is considered as unavailable (not generating) on average in January and 80% in July. 60% of the installed solar capacity is considered as unavailable on average at 11 AM, 100% at 7 PM in both July and January. A part of hydro capacity is also considered as unavailable on average due to operating and environmental constraints. Fossil fuels unavailability (maintenance and outages) are calculated from historical average data.

Load

The ongoing global economic crisis leads to a slowdown in electricity demand growth, which explains a downward revision of electricity demand growth in the best estimate load forecast considered in both scenarios A and B, in line with the ñReferenceò scenario of the 2013 edition of the French Generation Adequacy report.

Remaining Capacity

Adequacy Reference Margin has been calculated considering winter period as October to March, and summer period as April to September.

Without additional investments, Remaining Capacity minus Adequacy Reference Margin will significantly decrease from now on to 2025, and security of supply could be threatened as soon as 2016.

Spare Capacity

Considering historical dispersion, 7.5% of NGC is applied.

2014 – 2025 – Scenario B

General comments

Security of supply should be guaranteed until 2016, with an important development of renewable energy sources capacity, limiting the impact of the retirement of fossil-fired capacity over this timeframe.

Net Generating Capacity

In this scenario, the NGC is globally increasing between 2013 and 2020, contrary to scenario A, with just a small decrease between 2015 and 2016, due to the planned closings of thermal units not compatible with IED directives. More oil units are considered to close in 2016 than in the previous edition of SO&AF, because no upgrade to norms has been done on these units yet.

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Scenario B differs from scenario A by these main hypothesises:

- For thermal units, 1.2 GW of CCGT units are expected to be installed between 2015 and 2025.
- For the renewable energy sources, in this scenario, an important development of RES capacity is considered.

Unavailable Capacity

Based on historical data, 70% of the installed wind capacity is considered as unavailable (not generating) on average in January and 80% in July. 60% of the installed solar capacity is considered as unavailable on average at 11 AM, 100% at 7 PM in both July and January. A part of hydro capacity is also considered as unavailable on average due to operating and environmental constraints. Fossil fuels unavailability (maintenance and outages) are calculated from historical average data.

Load

The ongoing global economic crisis leads to a slowdown in electricity demand growth, which explains a downward revision of electricity demand growth in the best estimate load forecast considered in both scenarios A and B, in line with the ñReferenceò scenario of the 2013 edition of the French Generation Adequacy report.

Remaining Capacity

Adequacy Reference Margin has been calculated considering winter period as October to March, and summer period as April to September.

In this scenario, Remaining Capacity minus Adequacy Reference Margin will decrease from now on to 2025, remaining positive until 2015, and becoming close to zero in 2016. Even if the security of supply should be ensured until 2016, the available adequacy margins will decline between 2015 and 2016, as stated in the summary of the 2013 update of the French generation adequacy report[5]:

Spare Capacity

Considering historical dispersion, 7.5% of NGC is applied.

2020 – Scenario EU 2020

General comments

This scenario is drawing a high vision for RES development, and a large implementation of efficient energy saving measures. It is built upon the figures mentioned in the French NREAP, but the installed capacities of RES are not exactly the same as in that document which has not been updated since its publication back in 2010.

Net Generating Capacity

In this scenario, hypothesises for fossil fuels are the same as in scenario B, considering NREAP does not cover them.

The development of wind power is consistent with the French NREAP. For solar capacity, as the development has been quite higher than planned, development should go beyond the NREAP objective. Thus, in order to stick to political targets, the solar capacity that has been considered in EU 2020 scenario is the sum of French regional objectives for 2020, called ñSRCAEò (Regional Schemes for Climate, Air and Energy).

Hydro power is not expected to progress significantly by 2020, so the capacity doesnót reach the values of NREAP.

[5] http://www.rte-france.com/uploads/Mediatheque_docs/vie_systeme/annuelles/bilan_previsionnel/update_generation_adequacy_report_2013_synthesis.pdf

The overall volume of renewable is superior to the French NREAP target.

Load

Load is lower than in scenarios A and B, resulting from efficient energy saving measures, consistent with general objectives of this scenario, in line with the ñStronger DSMò scenario of the 2013 edition of the French Generation Adequacy report.

2030 – Vision 1

The political context is not favourable to the development of renewable energies, mainly due to financial difficulties and a resolute commitment to scaling back support initiatives: the development of renewables is slow, and growth in the more capital-intensive segments (offshore wind, marine turbines) is close to zero. This context is positive overall for nuclear generation, with the operational life of plants extended as far as possible (around 80% of the plants) in order to reduce the investment requirement.

This scenario is in line for France with the ñLow growthò scenario of the 2012 edition of the French Generation Adequacy report[6].

2030 – Vision 3

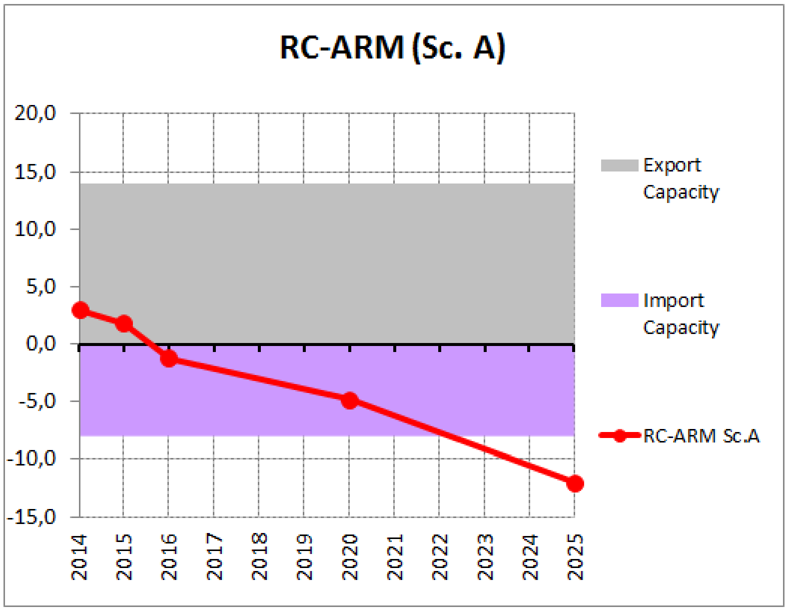
The vision 3 differentiates itself with a major commitment to overall demand-side energy management and a rapid transformation of the French energy landscape.

Significant efforts are made to enable the more widespread use of demand-side management which also encourages new electricity uses (heat pumps and electric vehicles, in particular), strong growth in renewable energies and a significant downsizing in the nuclear fleet via the decommissioning of a portion of the plants arriving at the end of their operational lives.

The economic environment and a marked change in the generation mix require the development of interconnection capacity.

This scenario is in line for France with the ñNew mixò scenario of the 2012 edition of the French Generation Adequacy report[7].

[6] http://www.rte-france.com/uploads/Mediatheque_docs/vie_systeme/annuelles/bilan_previsionnel/an/generation_adequacy_report_2012.pdf
[7] http://www.rte-france.com/uploads/Mediatheque_docs/vie_systeme/annuelles/bilan_previsionnel/an/generation_adequacy_report_2012.pdf


RC-ARM (Sc. A)
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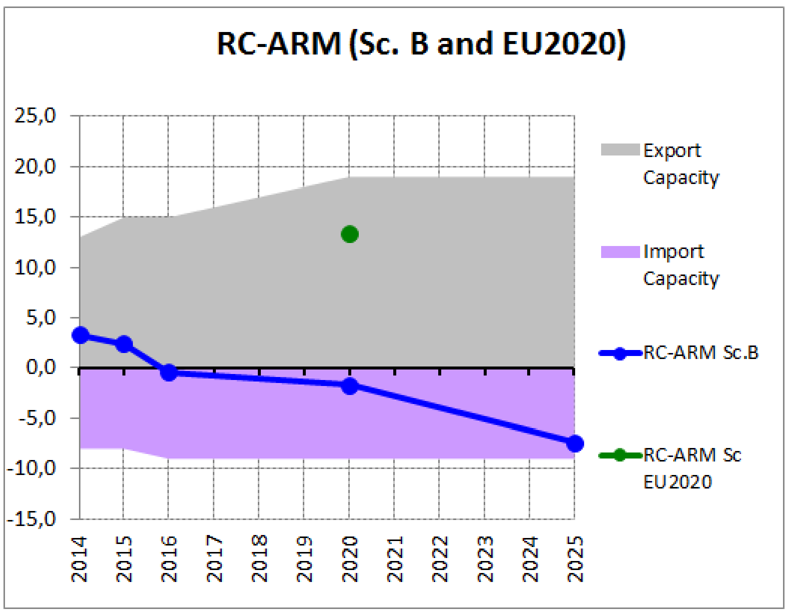
Export Capacity
Import Capacity
RC-ARM Sc.A


RC-ARM (Sc. B and EU2020)
25,0
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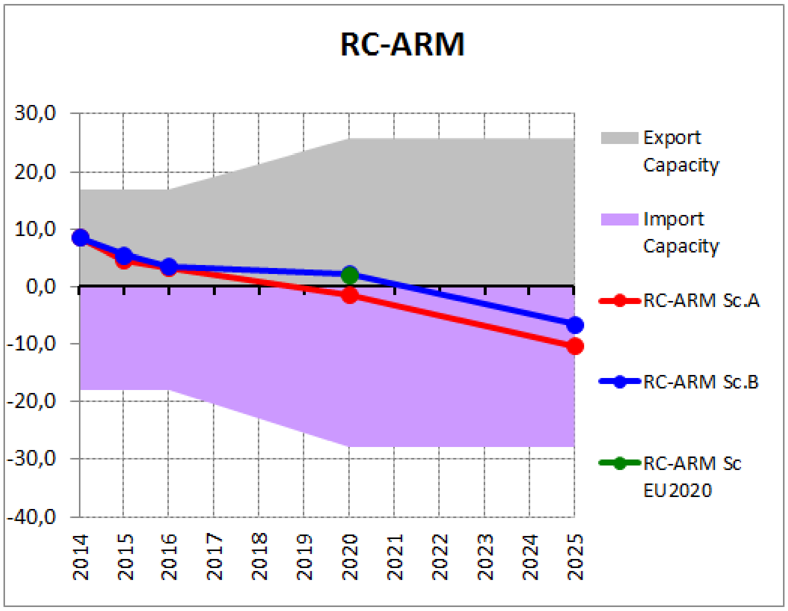
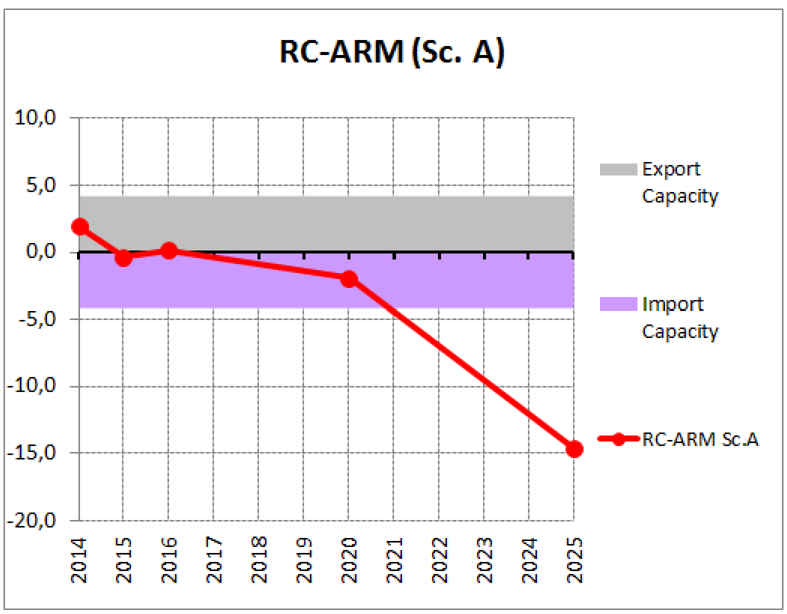
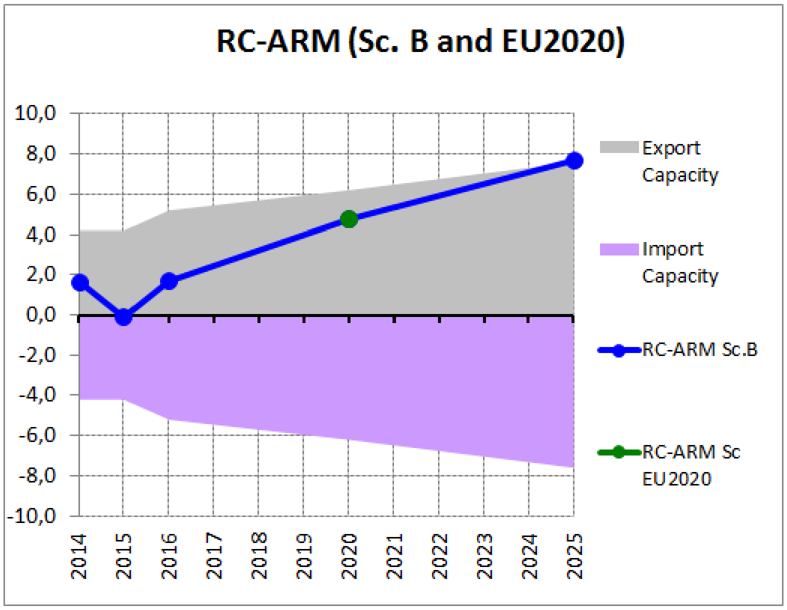
Export Capacity
Import Capacity
RC-ARM Sc.B
RC-ARM Sc EU2020

6.11 Germany



6.12 **Great Britain**





The EU 2020 Scenario is based on the 2013 Gone Green Scenario developed for the UK by National Grid. Gone Green has been designed to meet UK environmental targets ; 15 % of all energy from renewable sources by 2020, greenhouse gas emissions meeting UK Government carbon budgets out to 2027, and an 80% reduction in greenhouse gas emissions by 2050.

The EU 2020 Scenario and Scenario B, the “Best Estimate”, are identical.

Generation capacity and load data are all for the National Grid transmission system and do not include generation connected to lower voltage distribution networks. The data represent around 90 % of the total GB electricity market.

Generating Capacity

- The only new capacity included in Scenario A is that which is already under construction or where the project is too far advanced to be cancelled;
- Between 2 GW and 3 GW of coal and oil plants will close between 2014 and 2015 in response to the Large Combustion Plant directive (LCPD);
- In Scenario A and B for 2014 to 2020 there is a downwards and upwards change of c1GW of gas plant respectively. These are the net impacts of the closure and opening of gas plants.
- No CCS plant on gas or coal generating capacity is built before 2020;
- In Scenarios B and EU 2020, 7 GW of offshore wind and 5GW of onshore wind capacity is built between 2014 and 2020;
- There is no significant development of tidal or wave capacity, nor is there a significant increase in the existing hydro or pumped storage capacity.

Unavailable Capacity

For the purposes of this analysis the system services held by the TSO has been included in the Unavailable Capacity calculation in line with the ENTSO-E method. This has the net affect that for Scenario B (UK 2013 Gone Green), the Generation Adequacy touches zero in 2015/16. If Scenario B was adjusted in line with the GB capacity adequacy method in how it treats TSO system services, then the net effect is the generation adequacy for Scenario B shifts upwards by 2-3GW. Therefore while 2015/16 has the lowest generation adequacy for Scenario B, it doesn’t cross through zero.

Load

There are many different factors, both positive and negative, which affect the development of electricity demand. However, the net effect of these is a small change in demand between 2014 and 2020.

- In Scenarios B and EU 2020 there is an ambitious roll out of domestic heat pumps but not until the mid-2020s.These pumps are replacing inefficient electric resistive heating which leads to a decrease in electricity demand;
- There are further reductions due to efficiency gains in domestic appliances and the replacement of incandescent bulbs with low energy lighting;
- There is also an increase in generation, although this is not connected to the National Grid transmission system.

Generation Adequacy

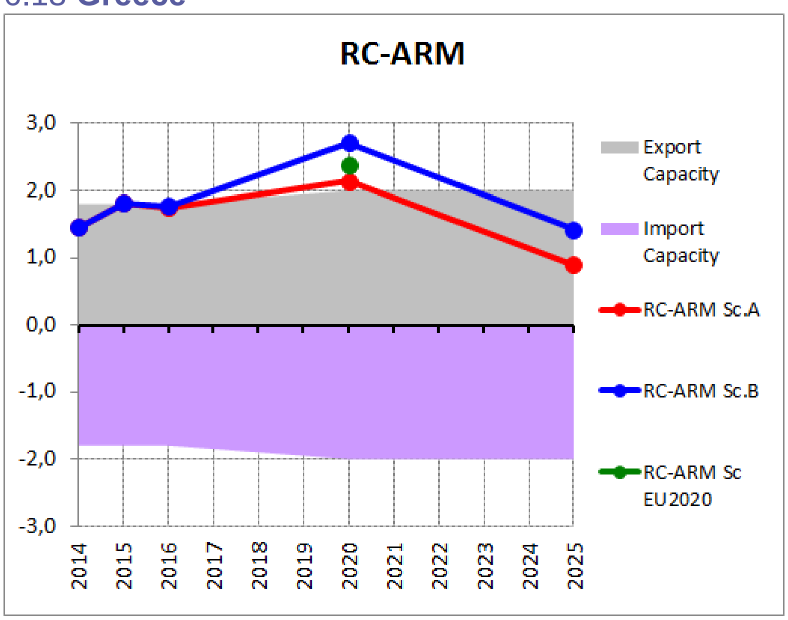
In the GB market there are no national adequacy standards which correspond directly with those being calculated in this document. There are planning standards to plan the long-term development of the system and to ensure that adequate Transmission capacity is available. There is no mechanism in the GB market to fund generation over and above the reserve capacity that the System Operator contracts for. In essence, it is for the market to provide adequate generation and respond to the relevant market signals. Our long-term plans consider the prospective generation projects which could potentially be developed and assumes that the market responds to the relevant signals.

In December 2013 the UK Government introduced an Energy Bill to parliament which, if implemented, will create a generation capacity market. This market will in turn allow for capacity auctions from late 2014 for the delivery of capacity in the winter of 2018 / 19. This will result in certain changes to the market structure detailed above.

Interconnection Capacity

In Scenarios B and EU 2020 there is 3.4GW of new interconnection built to/from GB during the analysis period.

6.13 Greece



General Comments on all scenarios

All data provided by IPTO refer solely to the system of the mainland and the islands that are interconnected to it.

For the construction of all Scenarios it is considered that in the year 2017 the Cyclades islands will be interconnected to the system of the mainland, while the island of Crete will be interconnected in the year 2021.

Comments on NGC

Currently, there are two mechanisms considering new generation in the Greek system: the market-driven mechanism and through tenders by IPTO to ensure adequacy. The values presented here for years after 2016 are indicative.

The generation license granted to PPC (Public Power Corporation) and recent legislation, allow PPC to substitute existing old generating units with new capacity, of the same magnitude. Furthermore, several lignite-fired PPC units will have to be decommissioned since they will not be able to comply with stricter European environmental directives. PPC has announced a large-scale program, through which it plans to install new generating capacity, while at the same time decommissioning old inefficient units (mainly lignite and oil units). The extent of the decommissioning schedule and the exact timeframe are not clearly defined. Based on the available information to IPTO at that time, scenarios for the previous SO&AF 2013-2030 were constructed under the assumption that by the year 2020 a total of 3411 MW would be decommissioned. Newer information leads to a considerable down-scale of this decommissioning plan, amounting to a total of 1746 MW by the year 2020, which has been taken into account in the construction of all Scenarios for the current SO&AF 2014-2030.

Scenarios A and B

Due to the prolonged economic crisis and the limited funding of projects through banks no new investments in thermal units are anticipated up to the year 2020, besides the projects that are already being constructed, or have already been contracted. Due to this, thermal NGC is considered the same in both scenarios A and B.

Considering renewable energy sources, and in view of achieving national set targets for 2020, new legislation has given strong motivation for the installation of RES, as well as simplifying licensing procedures. A large number of RES projects have been announced by investors. Scenario A assumes that a small portion of these will be realized, while in Scenario B it is assumed that a larger portion of these will be realized (including RES projects on islands that will be interconnected in the time frame examined).

Scenario EU2020

Data for constructing the scenario EU2020 has mainly been obtained from the Greek NREAP and its accompanying Committee Working Paper that provides detailed background information on the assumptions made. It should be noted that the Greek NREAP refers to the entire country and therefore all values have been appropriately scaled down in order to reflect only the interconnected system of the mainland (and the islands interconnected to it).

Values provided for loads and RES in scenario EU2020 are lower than those provided in the previous SO&AF 2013 ï 2020 since the interconnection of the island of Crete is expected to be delayed till 2021. In SO&AF 2013-2030 this was foreseen to be realized in 2019 and therefore provided values also included the loads and RES of Crete.

Vision 1

Regarding thermal NGC, Vision 1 has been constructed based on the given guidelines. Most new projects are assumed to be CCGTs.

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On-going licensing procedures and implementation of RES projects indicates that photovoltaic projects are realized at a considerably higher rate than anticipated and by the year 2020 the installed capacity of photovoltaics will exceed the set target of Greek NREAP. On the other hand, the installation of wind parks does not seem to be proceeding as anticipated. Due to this, installed capacities of wind parks and photovoltaic have been appropriately altered in order to reflect these trends, while still maintaining the same set targets of RES generation for the year 2020.

Vision 3

Vision 3 has been constructed based on the given guidelines.

Comments on Unavailable Capacity

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.

Furthermore, it is considered that solar units do not contribute at the first reference point (3rd Wednesday of January on the 19th hour).

Additionally, limitation of availability of thermal units due to temperature (heat) is considered for the second reference point (3rd Wednesday of July on the 11th hour).

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.

Comments on Load

Due to the prolonged economic crisis, growth rate of the electricity demand in Greece has decreased considerably, compared to previous years.

Loads provided for every scenario refer to the total demand (loads at the transmission level, as well as dispersed generation from RES at the distribution level) for the mainland and the interconnected islands.

Scenario A and B:

Values provided are obtained from the most recent load forecasting studies performed by IPTO and are considerably lower than the values considered in the previous SO&AF 2013-2030.

Scenario EU2020:

Values provided are obtained from the national NREAP and are adapted appropriately in order to reflect only the interconnected system of the mainland (and the islands interconnected to it). These national NREAP load forecasts have not been updated and therefore are considerably higher that recent load forecasts utilized in scenarios A and B.

Vision 1:

Values provided are obtained from the draft version of the national ōRoadmap to 2050ô and are adapted appropriately in order to reflect only the interconnected system of the mainland (and the islands interconnected to it).

Vision 3:

Values provided are obtained using the methodology provided in the guidelines.

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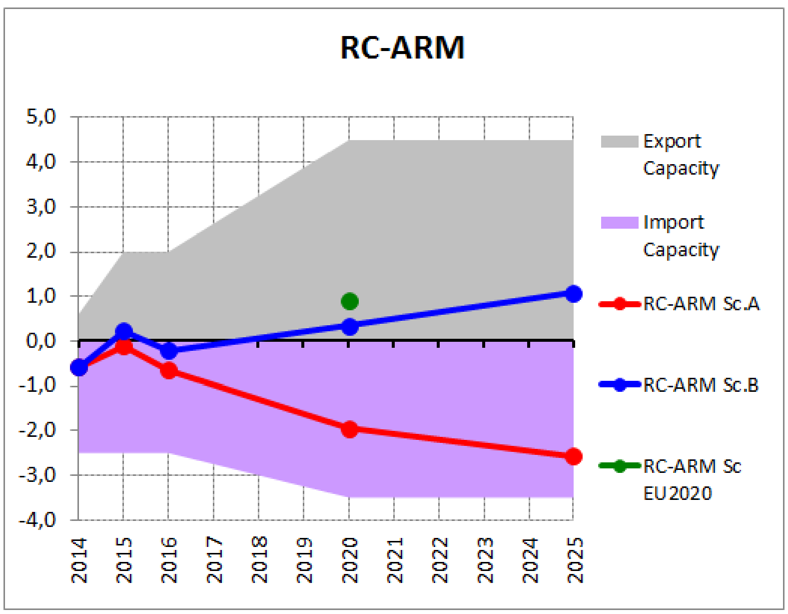
Comments on RC-ARM

It can be seen than RC is positive for every year of the studied period, therefore the Greek system seems to be adequate enough and some generating capacity will be available for exports under normal conditions. Despite the lack of new investments in thermal plants and the additional loads that need to be met due to the interconnection of some islands the RC index remains relatively stable over the years. This can be attributed to the RES projects expected to be connected to the system.

For scenarios A and B, the index RC-ARM is positive for all the years of the study period, suggesting that security of supply is likely to be guaranteed in most of the situations, while exports may be possible even under severe conditions. As expected, the considerable down- scale of the decommissioning plan of PPC units (compared to assumptions made in the previous SO&AF) has improved the adequacy indicators up to the year 2025.

For the scenario EU2020 the index RC-ARM is also positive, even though higher loads are assumed compared to scenarios A and B.

6.14 Hungary



6.15 Ireland

Generating Capacity

Calculations are based on data collected from market participants for the óAll-island Generation Capacity Statement 2014-2023ô. According to Irelandôs National Renewable Energy Action Plan, 40% of electricity should be generated from renewable sources by 2020. This means that there will be a significant increase in renewable generation, mostly consisting of wind generation

New market rules (I-SEM) are currently being developed and should come into force after 2016. At this time, it is not known what impact the new market design might have on decisions by market participants to commission and decommission generation capacity.

Unavailable Capacity

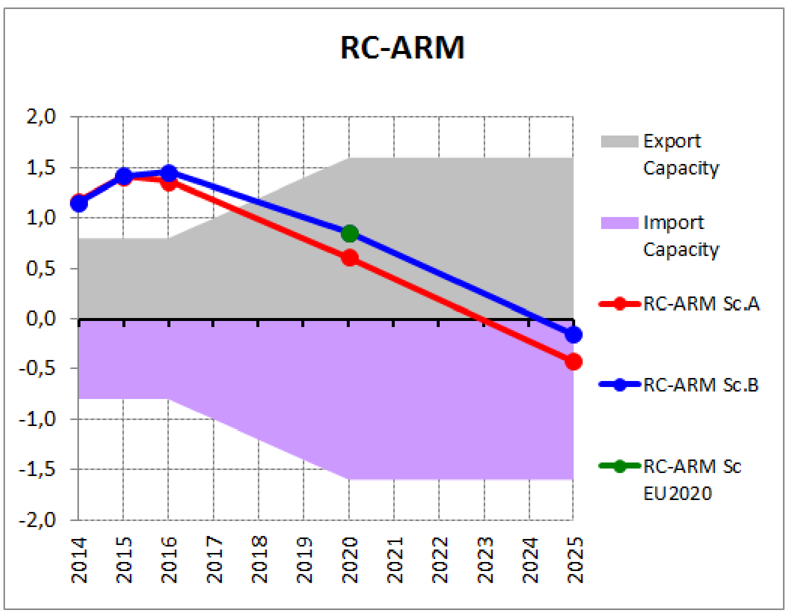
A probabilistic adequacy assessment of the wind generation, which examines historical data over multiple years, has been undertaken to calculate the appropriate capacity contribution of the large amounts of wind generation currently installed and due to commission.

Generation Adequacy

Generation adequacy is acceptable up to 2020. However, the impact of new market rules (I-SEM) on generation capacity post 2016 is uncertain at this time.

Interconnection Capacity

A second interconnector with Northern Ireland is expected to be commissioned prior to 2020.



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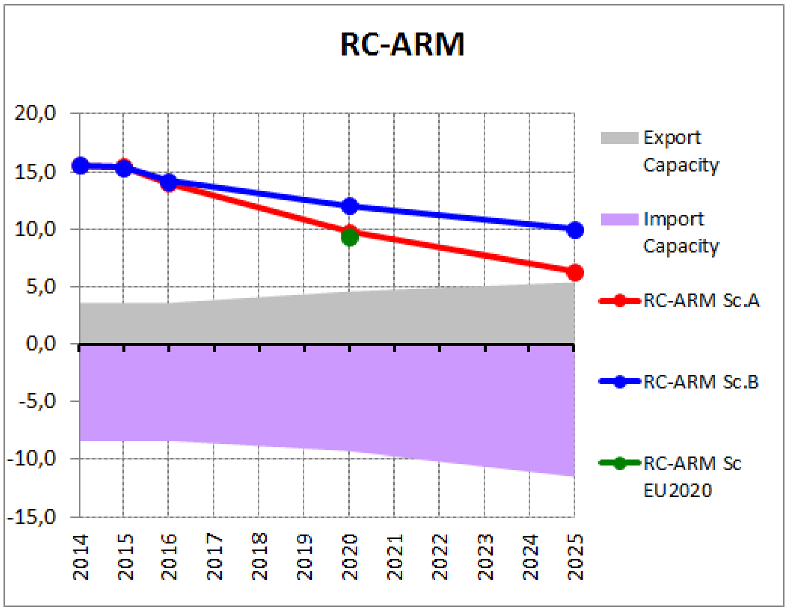
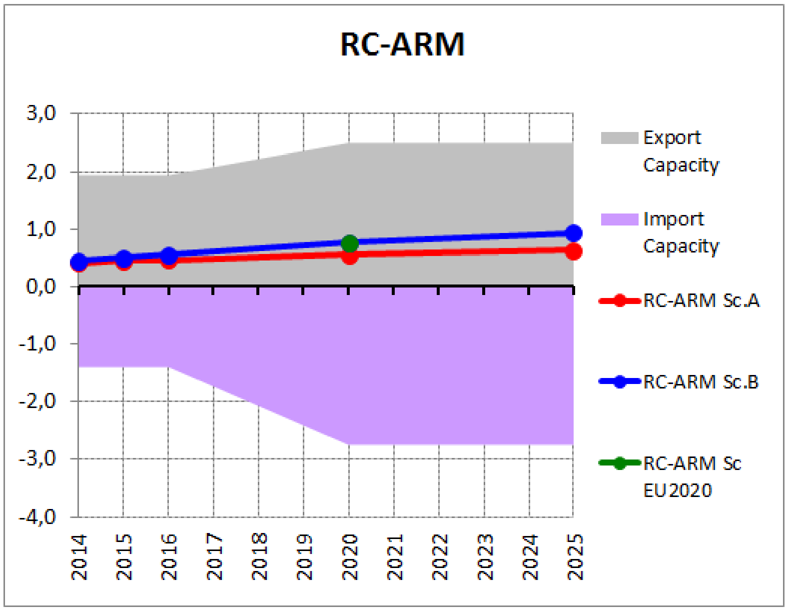
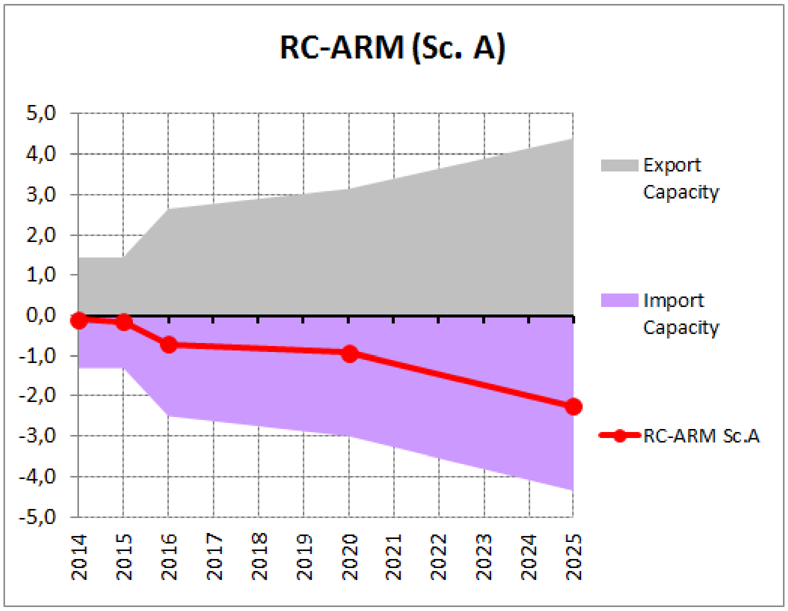
6.16 **Italy**

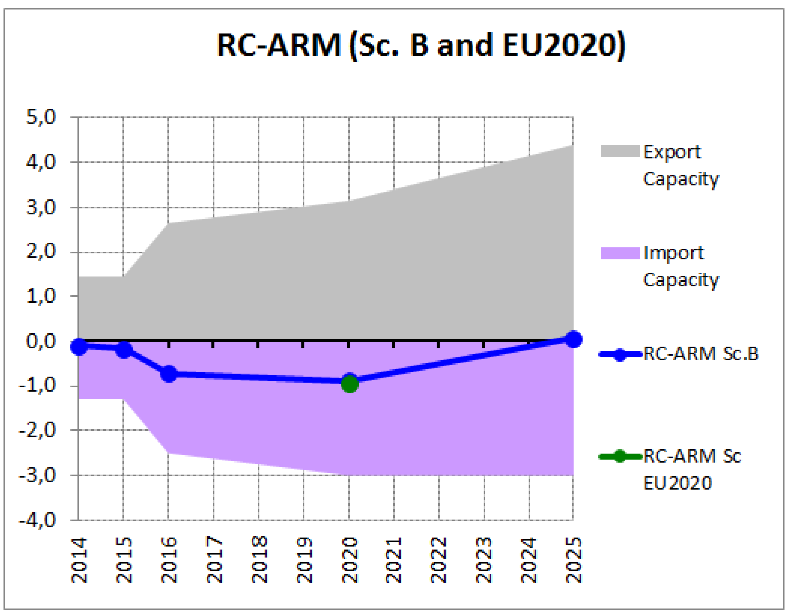


6.17 **Latvia**



6.18 Lithuania





Comments on NGC

Following the definition of scenario A, no additional fossil fuel generating capacities were taken into consideration. RES development is obtained by using information from National Renewable Energy Action Plan (NREAP), Law on Renewable Energy and other laws governing the development of RES. EU2020 scenario coincides to scenario A, as new fossil fuel generation is not foreseen and RES development is based on the same legislation.

For the scenario B few new power units estimated: new Visaginas nuclear power plant and new 5th unit in pump storage power plant. Construction of New nuclear is set in National Energy Independence Strategy of the Republic of Lithuania. RES development is assessed following the actual amount of issued technical requirements for RES connection to the network.

Decommissioning of old units was evaluated in all scenarios and Visions and is based on information, provided by generating companies (annual survey performed).

Comments on Unavailable capacity, RAC

Unavailable capacity includes 94 % of wind power capacity and 75 % of HPSPP NGC is considered as unavailable. It is assumed that maintenance and overhauls will take place during the summer period. During the period 2014-2016 the largest PP in Lithuania declared its intention to suspend maintenance of old units. Respectively decrease in RAC during this period is visible.

Comments on load

Load forecast is based on GDP growth forecast, as the main factor influencing energy demand is change of GDP. It is assumed that load for A, B and EU 2020 will be the same.

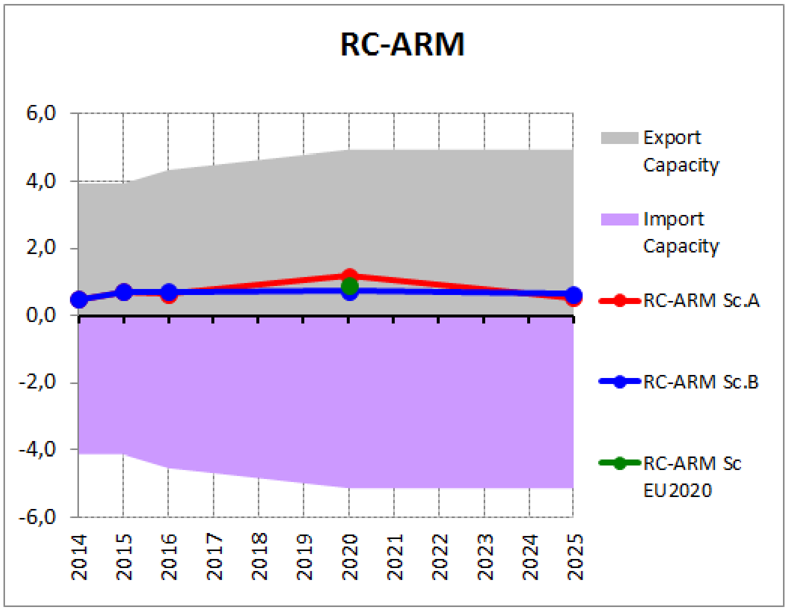
Comments of RC (sc. A, B, EU2020)

For all three scenarios (A, B and EU 2020) RC becomes negative in 2015-2016 period (caused by capacity reduction in Lithuanian PP) and in the end of analysed period (the year 2025). However, even if Lithuania has enough capacity to cover peak demand (except 2015-2016 period and the year 2025), local generation costs are not competitive compared with an imported electricity cost (mainly from Russia).

Comments on Transportable/Interconnection capacity (sc. A, B, EU 2020)

In each scenario a new 400 kV double circuit line to Poland (LitPol Link project) and a new 300 kV submarine cable line to Sweden (NordBalt project) were assumed. Start of operation LitPol Link interconnection is expected in December, 2015 and NordBalt interconnection (700 MW capacity) is expected to be in operation in 2016. Currently Lithuania does not have any connection to the Continental Europe synchronous area.

6.19 **Luxembourg**



6.20 **FYR of Macedonia**

Generating Capacity

Macedonian power system currently has low production of renewable sources. 150 MW of wind energy are expected to be integrated by the end of 2015. The following assumptions were made to create the following scenarios:

Scenario A

This scenario takes into account the additional necessary investments in generation which are crucial in maintaining the security of the supply. These include new power plants considered as certain and their commissioning decision can no longer be cancelled. The installed capacity by the type of fuel for 2020 is the following:

- Fossil fuels: 1153 MW,
- Renewable sources: 186 MW,
- Hydro: 808 MW (of which 76, 4 MW are new).

Scenario B

This scenario is built on the basis of the previous scenario, but extended with the future power plants which commissioning can be considered as real according to the information available to the TSO and obtained from multiple sites. The installed capacity by the type of fuel for 2020 is the following:

- Fossil fuels: 1383 MW (of which 230 MW from gas plant are new),
- Renewable sources: 239 MW,
- Hydro: 1150 MW (of which 479 MW are new).

EU 202020

This scenario is built on the National Strategy for the utilization of renewable energy sources in the country by the end of 2020 and an Action plan for its implementation. The installed capacity by the type of fuel for 2020 is the following:

- Fossil fuels: 1383 MW (of which 460 MW from 2 gas plants are new)
- Renewable sources: 290 MW, (of which 180MW wind)
- Hydro: 1211MW (of which 560 MW are new).

Vision 1 & 2

The general assumptions in this vision is that the economic and the financial conditions are less favourable compared to the other visions and a consequence of the national governments having less founds to reinforce the existing energy policies. Furthermore, the absence of a strong European framework is a barrier to the introduction of fundamental new market designs that fully benefit from R & D in Vision 1.

For Vision 2, there is a strong European framework but due to the economic and financial outlook the introduction of the fundamental new market designs and R & D expenses it focuses on the cost cutting and not the goals of the Energy Roadmap 2050. The installed capacity by the type of fuel for 2030 for Vision 1 is the following:

- Fossil fuel: 965 MW,
- Renewable sources: 295 MW,
- Hydro: 1415 MW.

Vision 3 & 4

The general framework during the construction of these visions is the economic and financial conditions being more favourable than in the previous visions. For Vision 3 it is assumed an absence of a strong European framework which is a barrier to the introduction of the fundamental new market designs which fully benefit from R & D. In Vision 4 the strong European framework introduces fundamental new market designs which full benefits from the R & D. The installed capacity by the type of fuel for 2030 is the following:

- Fossil fuels:
  - Vision 3: 1195 MW (of which 690 MW from 3 gas plants are new),
  - Vision 4: 895 MW, (of which 690 MW from 3 gas plants are new)
- Renewable sources: Vision 3 (464 MW), Vision 4 (745 MW),
- Hydro: 1886 MW for both visions.

Unavailable Capacity

Unavailability capacity is the sum of several values that depend on various factors. Generally unavailability is constant in terms of the poor quality of the fuel. In summer unavailability increases because thermo blocks cannot reach the nominal power because of the increased ambient temperature which is a limiting factor for the thermodynamic cycles. The restriction due to the unavailability of the hydropower regulation it is taken in to account because the reservoir is used for irrigation in the summer. Part of the unavailability which occurs only in winter is caused by insufficient primary fuel or hydro power plant running low of intake water. In summer due to the maintenance an unavailability of 200 MW occurs from one of the thermal blocks. System Service Reserves are variable and are depending on the maximum load and installed capacity from the fossil fuels.

Load

Forecasted consumption is a combination of realized consumption until 2013, the planned consumption according to energy balance until 2018 and the percentage increase in load which is different for each scenario. The percentage increase in load used for the forecast depends on the growth in the distribution sector, industry development and investment in energy efficiency activities.

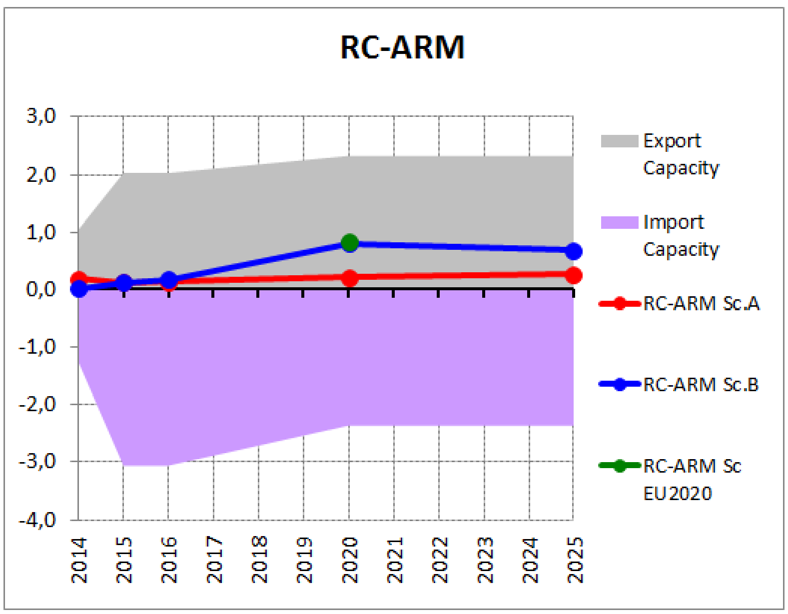
Generating Adequacy

Generally it can be concluded that for the observed years and scenarios a generation adequacy will be met if all the new forecasted production facilities are built.

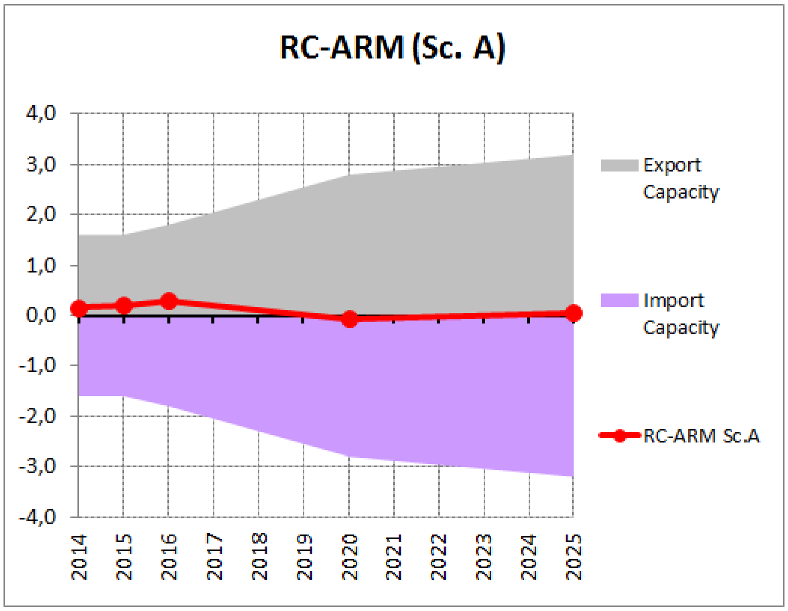
Interconnection Capacity

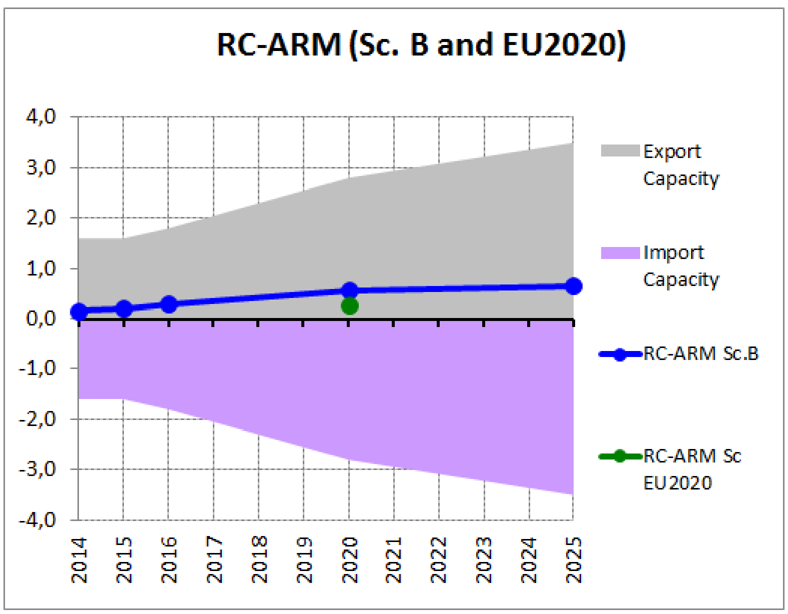
For the purpose of strengthening of Corridor 10 a new 400 kV interconnection transmission line SS Shtip (MK) ï SS Nish (RS) is planned to be in operation in 2014. A 400 kV interconnection transmission line SS Bitola (MK) ï SS Elbasan (AL) is expected to be in operation until 2020, which project is a part of the Corridor 8. If the construction of TPP New Kosovo is going as planned then a need of a new interconnection between Macedonia and Kosovo arises.

If the development of the transmission network is following the plan in trusted and reliable way then it can meet the need of the producers and the consumers of electricity. The cross-border transmission capabilities of Republic of Macedonia are such that they can support all the import or export electricity transactions to / from Republic of Macedonia, while not interrupting the transmission of electricity across the region.

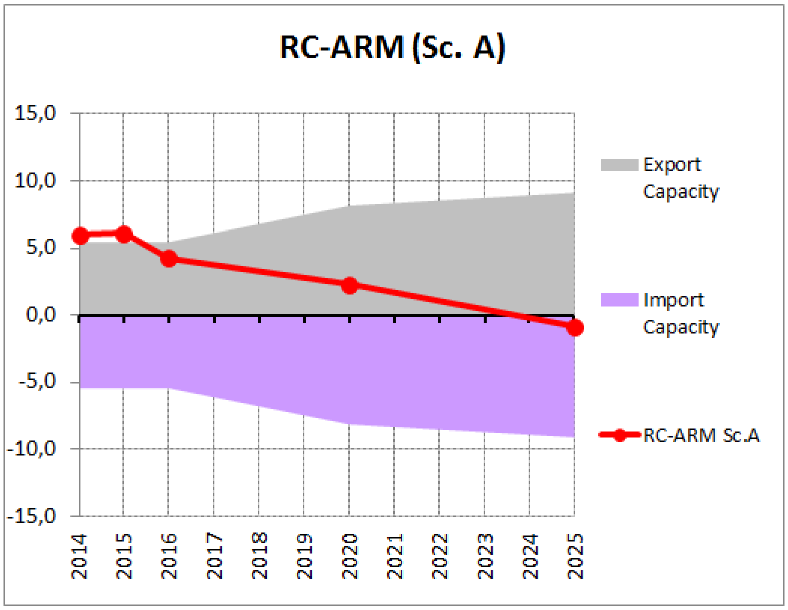


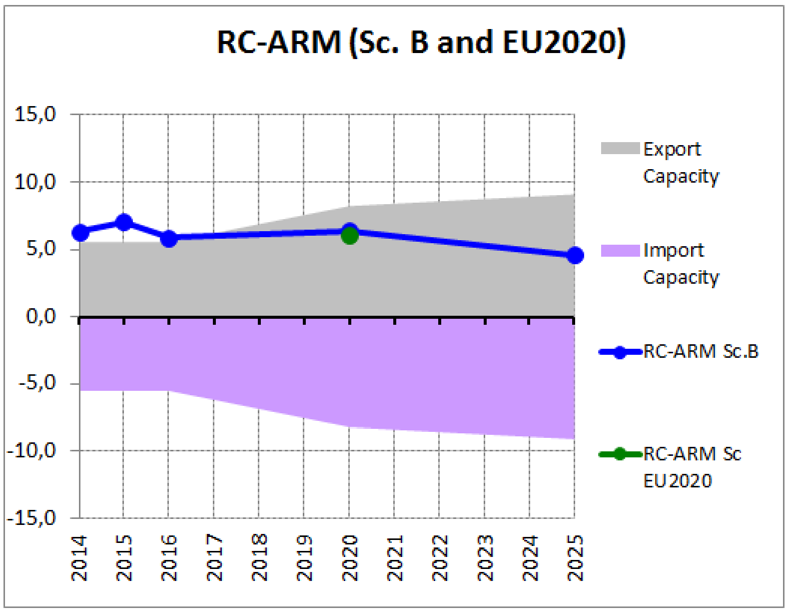
6.21 Montenegro





6.22 The Netherlands





Net Generating Capacity

The Dutch Energy Agreement (so called '*Energie Akkoord*') settled in the summer of 2013 has been taken into account with regard to thermal generation capacity. The early closing of the oldest coal units will be effected in 2016 (1.61 GW) and 2017 (1.05 GW), which overrules all present scenarios and as a consequence the NREAP in building scenario EU2020. For all scenarios the new built coal fired capacity (3.37 GW) will be taken into account while coming on line 2014. All together this results in a net growth of 0.7 GW coal fired capacity in 2017 and lasting further on.

The installed fossil fuels generation capacity in the Netherlands in the conservative scenario (A) in 2020 is extending more than 9% in comparison with year 2013 (24.0 GW) towards an amount of 26.2 GW. Capacity of gas fired units will extend with 1.5 GW. Growth of renewable power in this prudence scenario limits to 0.4 GW in 2020 (3.4 GW) in comparison to 2013 (3.0 GW).

Scenario B shows an amount of 26.4 GW of fossil fuels generation capacity in 2020, approximately a growth of 10% in comparison with year 2013. Besides the coal fired units extension of 0.5 GW the capacity of gas fired units will extend with 1.6 GW. This best estimate generation scenario also includes an increasing amount of 3.7 GW of wind power capacity towards 6 GW in 2020 and an assumed growth of 3.7 GW of solar power capacity to 4 GW in 2020.

So the NGC in 2020 shows nearly 30.1 GW in scenario A and 37.4 GW in scenario B. For scenario EU2020 the NGC in 2020 will be 38.8 GW. The 3.4 GW of mothballed gas fired units reported by electricity generation companies in 2013 will decreasing the NGC in 2020.

The EU2020 scenario was primarily based on the Dutch National Renewable Action Plan (NREAP). In this NREAP the total value of renewable supply was translated into the scenario EU2020 in two separate parts: 11.92 GW renewable capacity by primary fuel capacity and 2.25 GW renewable by secondary fuel capacity, the latter being biomass in coal fired units. The waste incineration capacity can be distinguished into renewable capacity (biogenic fraction) and non-renewable capacity (non-biogenic fraction). The total amount of wind power in 2020 in scenario EU2020 was estimated 7.8 GW. Other basic principles taken into account were derived from the best estimate scenario.

Unavailable Capacity, RAC

The difference of the NGC in 2020 in scenario A and B is mainly due to renewable capacity growth (7 GW). Besides maintenance, overhauls, outages, mothballing and system services taken into account, the reliable available capacity (RAC) is calculated very conservative because of the wind capacity factor. The unavailable capacity in scenario A adds up to 8.0 GW, in scenario B near 10.8 GW and in scenario EU2020 just about 12.3 GW. In all scenarios the Reliable Adequacy Capacity exceeds the 20 GW.

Load

The realised electricity consumption rates showing strong correlation with economic growth rates, including the lasting economic crisis in the Netherlands. The development of load pattern assumptions in scenario A and B was based on historic figures of electricity consumption. The basic assumption for the load assessment applied in this report is using the historic load pattern on the one hand and the total assumptions of annual demand on the other hand. The assessment of demand development in scenario A and B will be based on the 'Business as Usual' scenario in accordance with the latest Dutch Quality and Capacity Plan 2014-2023 (www.tennet.eu). In this BaU scenario demand increases 1.25% till 2021 and 1.0% beyond. For scenario EU2020 the load values were based on the ratio of the electricity consumption in the energy efficiency scenario of the Dutch NREAP and the SAF B demand, resulting in an average annual growth rate of 1.75% in this scenario.

Comments of RC and ARM and RC-ARM

Despite the poor development of the NGC in scenario A, this conservative scenario show positive figures on remaining capacity (RC). The RC 2020 for the scenario A is 7.4 GW in summer times and 5.5 GW in winter times. In scenario B the RC in the summer period is 11.8 GW and in the winter period the RC is 9.9 GW. Finally scenario EU2020 the RC in summer times is 11.6 GW and in winter times 9.6 GW. For all scenarios the Adequacy Reserve Margin (ARM) has a range of 3.2 to 4.0 GW in 2020.

So it might be foreseen that there will be a certain comfortable space for updating the installed generation capacity by replacing old or insufficient units. This process would be speeded up when the development of load can be reduced by savings according to the EU2020 scenario. However, the position of conventional generation capacity will be more difficult as the spark spread in the Netherlands does not improve in the medium term in a period of increasing renewable capacity.

Interconnection Capacity

<u>Extending interconnection capacities for the Netherlands</u>

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In 2011 the BritNed cable operated commercially: a HVDC bipolar installation including 260 km of 450 kV DC subsea cable between the UK (Grain) and the Netherlands (Maasvlakte) with an increase of 1.0 GW NTC. This is the first electricity connection between UK and the Netherlands. It is for enhancing diversity and security of supply for both markets open access for all market parties by explicit auction and market coupling increase of interconnection capacity and market transparency.

A new 400kV double circuit interconnection 60 km line between Germany (Niederrhein) and the Netherlands (Doetinchem) is foreseen in 2016 with increasing NTC as from 1.5 GW as a result of overloads due to high North-South power flows through the auctioned frontier between the Netherlands and Germany in peak hours of wind in-feed. Furthermore, under study is extending the capacity of the present interconnector between Meeden (NL) and Diele (Germany).

It is to be expected that a fourth phase shifter in 400 kV substation of Zandvliet (Belgium) for the benefit of the Dutch Belgian border will be installed. The interconnection capacity will be extended with 0.7 GW in 2016.

Further on there is COBRA under study for design & permitting 2019: a new single circuit HVDC connection between Denmark (Jutland) and the Netherlands via 350 km subsea cable; the DC voltage will be up to 320 kV and the capacity to 0.7 GW. Need to increase the current transfer capacity for the purpose of allowing for the exchange and integration of wind energy and increase the value of renewable energy into the Dutch and Danish power systems.

Under consideration was NorNed 2: a second HVDC connection between Norway and the Netherlands via 570 km 450 kV DC subsea cable with minimal 0.7 GW capacity. Need to increase the current transfer capacity between both countries as diversity of supply: connection between a hydro and a thermal power system. At the moment there is no date foreseen.

6.23 Northern Ireland

Generating Capacity

Calculations are based on data collected from market participants for the óAll-island Generation Capacity Statement 2014-2023ó. Under the ôStrategic Energy Framework for Northern Irelandô 40% of electricity should be generated from renewable sources by 2020. This means that there will be a significant increase in renewable generation, mostly consisting of wind generation.

At the end of 2015, 510MW of gas-fired generation will decommission due to environmental constraints as set by the Large Combustion Plant Directive. This will put security of supply at risk.

New market rules (I-SEM) are currently being developed and should come into force after 2016. At this time, it is not known what impact the new market design might have on decisions by market participants to commission and decommission generation capacity.

Unavailable Capacity

A probabilistic assessment of the wind generation, which examines historical data over multiple years, has been undertaken to calculate the appropriate capacity contribution of the large amounts of wind generation currently installed and due to commission.

Generation Adequacy

Northern Ireland security of supply is at increased risk from 2016 onwards. The commissioning of the second interconnector with Ireland will provide benefits in the longer-term as will restoring the Moyle interconnector (connected to Great Britain) to full capacity. However, the impact of new market rules (I-SEM) on generation capacity post 2016 is uncertain at this time.

Interconnection Capacity

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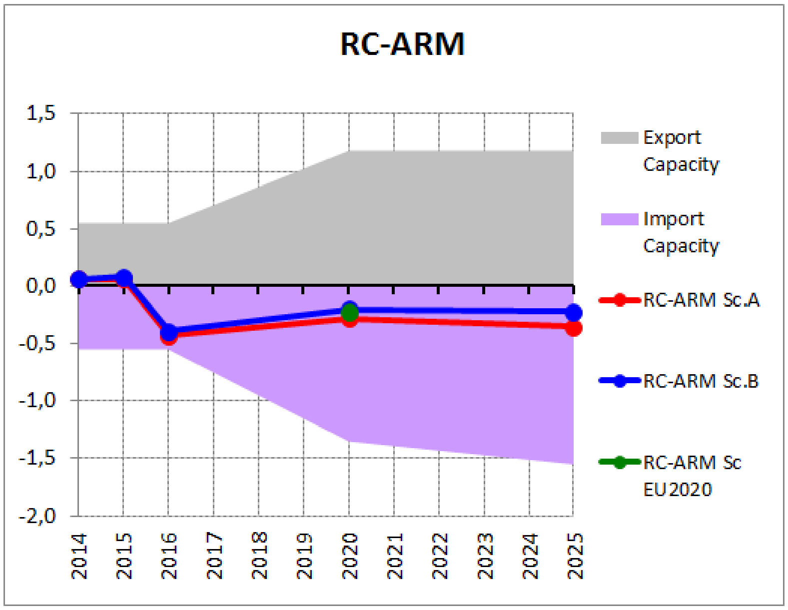
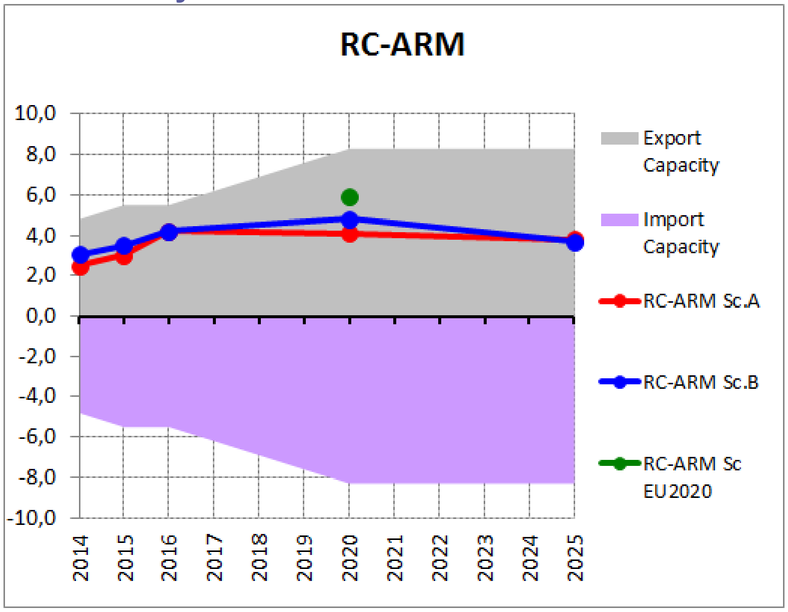
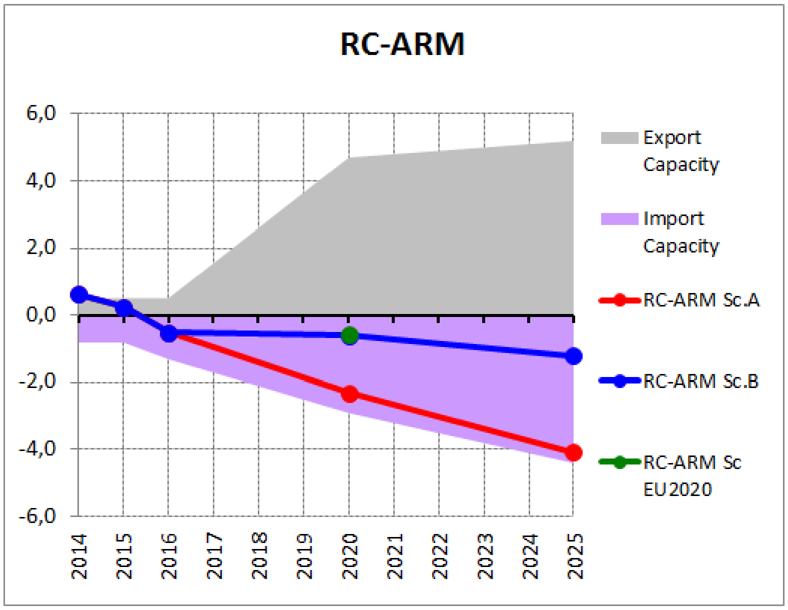
A second interconnector with Ireland is expected to be commissioned prior to 2020. The Moyle interconnector is currently on a partial outage, but should be back to full capacity prior to 2025.



6.24 Norway



6.25 Poland



General information about Polish data

Input data on generation and consumption for Scenario Outlook & Adequacy Forecast (SO & AF) 2014 ï 2030 was collected in January 2014. Data for January 2014 reference point is the forecast data.

Generation data for scenarios A and B is based on information from producers collected until December 2013. Load data in A and B comes from PSEôs own analysis prepared in March 2013.

Data for Scenario EU 2020 comes from the official Nuclear Polish Program prepared by the Ministry of Economy dated January 2014. This is the most up-to-date document with forecast concerning generation capacity and load development up to 2030.

All values in this report are net values.

National representativeness is 100 %.

Generating Capacity

Information on the subject of derogation clause from LCP and IE directives in Poland

During negotiations on its accession to the European Union (joined May 1, 2004), Poland achieved the derogation clause from LCP Directive (2001/80/EC), which came into effect in 2008 (for SO_2) and 2016 (for NO_X). The derogation clause from the Directive means, that the emission limit values will not apply until January 1, 2016 for SO_2 and January 1, 2018 for NO_X for selected power stations and combined heat and power plants (CHPs). No derogation for power plants is in force for dust.

The IE Directive (2010/75/EU) amends the LPCD and the IPPCD and introduces new, more restrictive limits concerning SO_2, NO_X and dust emissions for power plants as well as for CHPs. It will come into effect from 2016, although when taking into account the derogation described above, the new limits for NO_X emission will be in force in Poland not earlier than 2018, for the same (as for LCPD) producers. The IED has not yet been implemented in Polish law.

Main results of implementation of LPCD and IED on generation capacity

The Polish TSO, based on producersô declaration, assesses that in Poland the following amount of conventional thermal net capacity is to be decommissioned as a consequence of the results of LCPD and IED entering into force as well as exceeding the life span of units:

- 2.3 GW until the end of 2015;
- 1.3 GW between 2016 and 2020, mainly until the end of 2017;
- 4.3 GW is to be decommissioned between 2020 and 2030. The decommissioning after the year 2020 are mainly caused by exceeding the life span of units.

The total decommissioned conventional thermal net capacity in Poland till 2020 amounts 3.6 GW (7.9 GW till 2030). The amount of new conventional thermal capacity depends on how many project submitted to PSE will be realized. The Polish TSO assesses the level of new capacity until 2020 to approximately 4.5 GW.

Detailed information concerning NGC in SO&AF scenarios

a. Conservative Scenario A

Following the ENTSO-E definition, this Scenario indicates potential unbalance owing to a lack of new investments in the future. For thermal and nuclear power plants, PSE adopted the following criterion of confirmation regarding the execution of the investment: concluding an agreement (with subcontractors) by an investor for the construction of a unit. For other generating sources, mainly wind farms, Polish TSO has utilized the level of the net generation capacity which is to be reached within a four-year time horizon.

Taking into account the criteria mentioned above, there are three new commissioning of thermal units taking into account in this scenario ï 1000 MW of hard coal unit and 2x440 MW of gas (state as of December 2013). A development of wind generation up to the level of 5 GW installed capacity is envisaged.

b. Best Estimate Scenario B

NGC in this scenario is based on information from producers with regard to the investment projects by generators and takes into account the achievable level of new power capacity assessed by PSE, which amounts to approximately 4.5 GW in conventional thermal until 2020. Observed differences in dynamics of increased NGC and reliable available capacity (RAC) result mainly from the assessed unavailability rate of wind farms. Data in scenario B for the year beginning 2014 are identical to that for Scenario A.

c. Top down Scenario EU 2020

Net Generating Capacity data in EU 2020 is based on one of scenario from the official Nuclear Polish Program prepared by the Ministry of Economy dated January 2014. This scenario is taking into account conservative assumptions for nuclear power plants development as the result of other new investments, especially coal power plants.

d. Bottom-up scenario Vision 1 and 3

PSE S.A. decided to not change data in Vision 1 and 3, already provided to Pan European Market Modelling Database for TYNDP 2014, to be coherent with this document. The single exception is the decrease of nuclear NGC by 1.5 GW in both Visions 1 and 3 as the result of more conservative conditions for nuclear power plants development. In details there is:

- The level of capacity and generating sources structure are prepared according guidelines for Visions construction, means mainly: higher level of CO2 emissions prices in Vision 3

comparing to Vision 1, which causes, that more gas / less coal projects are took into consideration in Vision 3;
- Higher GDP in Vision 3 comparing to Vision 1, which causes higher load as well as more new capacity (other than fossil fuel) in the system in Vision 3;
- 35% more RES in Vision 3 comparing to Vision 1.

e. Top-down scenario Vision 2 and 4

These Visions are built by ENTSO-E on the basis of Vision 1 and 3. For Poland the differences are:

- Higher load in Vision 2 compared to Vision 1;
- Much higher load in Vision 4 than in Vision 3;
- Extremely difficult to implement increase of RES in vision 4 comparing to Vision 3. The increase amounts approximately 100%. It is necessary to underline that the level of renewable sources provided to Vision 3 is already very optimistic in PSE point of view.

Load

The forecast yearly peak load (as load at reference point + margin against seasonal peak load), taking place during the winter season, grows as follows:

a. In scenario A and B, there is 1.35%

b. In scenario EU2020, there is 1.5%

c. In Vision 1, there is 0.8%

d. In Vision 3, there is the same increase as in EU2020 ï 1.8%

All above values concern yearly peak load, which will take place during the winter season. The growth of summer peak load (meaning morning peak load during the period between June and mid-August), is higher than that for winter season by approximately 0.4%. All comparisons are made on the basis of forecast for scenario B in 2013.

Generation Adequacy

To make results comparable, the same way for calculation details of unavailable capacity and Adequacy Reference Margin was used in all scenarios and for all reference points.

1. Unavailable capacity

Elements of unavailable capacity and short description:

a. Non-usable capacity:

- average factor of unavailability of onshore wind generation is 90%, for offshore there is 90% as well;
- average factor of unavailability of solar is 100% in January reference point and 90% in July;
- technological limitation of production in combined heat and power plants (summer season);
- restrictions owing to cooling water temperature in certain thermal power plants (summer season);
- limitations owing to transmission network capacity constraints caused by high temperature (summer season);
- increase of the heat production in combined heat and power plants (winter season);
- part (ca. 40 %) of pump storage total availability is treated as non-usable (usage of hydro power determined by duration of peak load in winter season).

b. Maintenance and overhauls:

Long- and mid-term level of maintenance and overhauls were taken into account.

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c. Outages:

- forced outages;
- outages owing to unexpected faults during the start of the unit within on-going maintenance process.

d. System Services Reserve:

PSE sets the level of primary reserve according to ENTSO-E requirements and secondary reserve at the level of the potential outage of largest element in the system (bus bar, unit). Both reserves are kept in conventional thermal system power plants.

2. Remaining capacity / Remaining Capacity minus adequacy reference margin

In both TSOôs Scenario A and B, RC-ARM for years 2014, 2015 and 2016 is the same, because until 2016 no differences in commissioning are forecasted. Beyond year 2015 RC-ARM is negative for all scenarios in all reference points, however system may be balanced using importable capacity of interconnections.

a. Scenario A

RC-ARM in this Scenario significantly decreases, particularly after the year 2015. This results from the decommissioning caused by the LCP Directive and IE Directive coming into effect as well as the limitation of unitsô lifespan (only three new thermal units are confirmed after the year 2014: first two in 2016, third in 2020).

b. Scenario B

After the two-years decrease of RC-ARM in this scenario there is stagnation until 2020 forecasted, because additional two big (2 x c.a. 830 MW) hard coal units are planned for commissioning in 2020 comparing to scenario A. Also bigger increase of RES is taken into account than in Scenario A. Beyond year 2020 except for increase of RES only single nuclear unit in 2025 (c.a. 1500MW) is forecasted (it will be first nuclear unit in Poland). These commissionings are not enough taking into account the growth of load and decommisionings in this period, so RC-ARM will decrease again.

c. Scenario EU 2020

Both load and NGC values in Scenario EU 2020 are similar than in Scenario B, thus meaning that RC and RC-ARM in 2020 are very close to Scenario B values.

3. Spare Capacity

Polish TSO assumes 5 % of NGC.

4. Margin against Seasonal Peak Load

For Poland the representative season for winter comprises December, January and February (peak load takes place between 5 p.m and 6 p.m).

For summer it is the period between June and mid-August with a daily peak load at 1:15 p.m. The time of occurrence of this peak load justifies the choice of the representative months for the summer period. Indeed, statistically speaking, before and after this summer period, the daily peak loads take place in the afternoon. The calculation of Margin against Seasonal Peak Load is based on statistical data and its value is constant for the forecast period.

Simultaneous Interconnection Transmission Capacity (SITC)

PSE follows a single coherent vision of cross-border interconnection development, and therefore the values presented in Scenario A are the same as in Scenario B, EU2020 and 2030 Visions: 1 and 3. There are also no differences between NTC in 2030 Visions: 1 and 3. Data for Vision 2 and 4 includes additional projects, which could be analyzed.

NTC [1] [MW]	2014	2015	2016	2020	2025	2030	2030
	PSE forecast for scenarios: A, B, EU 2020, Vision 1 and Vision 3						Visions 2, 4
PL->DE/CZ/SK [2]	400/900 [3]	400/900 [3]	400/900 [3]	2500	3000	3000	3000
DE/CZ/SK [2] ->PL	0	0	0	500	2000	2000	2000
PL->SE	100	100	100	600	600	600	600
SE->PL	600	600	600	600	600	600	600
PL->UA [4]	0	0	0	600	600	600	600
UA->PL	220	220	220	820	820	820	820
PL->LT [5]	not applicable		0	1000	1000	1000	1000
LT->PL [5]	not applicable		500	1000	1000	1000	1000
PL<->Baltic area [5, 6]	not applicable						600
PL<->Nordic area [5, 6]	not applicable						700
PL export	500/1000	500/1000	500/1000	4700	5200	5200	6500
PL import	820	820	1320	2920	4420	4420	5720

Cross-border interconnections development in January's reference point (state as of January 2014)

1) Values presented in the table are NTC values forecasted in yearly horizon at peak time. State as of January 2014. Capacity offered to the market may differ from values shown above.
2) PSE gives aggregated data for the whole synchronous PL-DE/CZ/SK profile.
3) Winter/summer season.
4) Radial connection using 220kV Zamosc-Dobrotvir line at the moment.
5) Back-to-back connection.
6) Additional projects (which could be analyzed) as the result of building ENTSO-E top down scenarios: Vision 2 and 4.

Changes in Simultaneous Interconnection Transmission Capacity (SITC) indicated for:

2016:

- New 400 kV double circuit line Alytus-Ełk building with back-to-back in Alytus SS (PL-LT).

2020:

- Physical phase shifter installation in substations connected Polish and German systems (synchronous profile);
- Change in the voltage level for the Krajnik-Vierraden line from 220 kV to 400 kV (synchronous profile);
- Improvements of internal grid in Northern part of Polish system (PL-SE);
- Installation of B2B between Poland and Ukraine (PL-UA);
- Realization of second stage of PL-LT connection (PL-LT).

2025:

- Third line between PL and DE (synchronous profile).

2030 (Vision 2 and Vision 4):

- Possible projects (asynchronous connection).

6.26 **Portugal**

Generating Capacity

The Portuguese electricity system is currently characterised by high penetration levels of renewable energy, supplying in 2013 more than 57 % of total electricity consumption. The Portuguese strategy for energy development leads to an important growth of RES, mainly based on wind generation. Further, goals have been set for 2020, considering new pumped-storage hydro, wind and solar generation development.

Scenario EU 2020 is based on national energy policy drivers defined by the Portuguese government. Estimations under Scenario B support the same evolution of the Portuguese system. Main developments include the development of renewable energy sources until 2020, particularly wind power, reaching 5300 MW as well as 3280 MW of new large hydro power plants (2660 MW equipped with pumping). The capacity installed in pumped-storage hydro power plants, that adds extra 1100 MW between 2020 and2025, along with the development of new interconnections, is of absolute importance to successfully compensating the volatility of intermittent generation from wind and solar. New already-licensed CCGT units total a capacity of 1,766 MW.

In Scenario A, a conservative approach is used, meaning that no further generation capacity is assumed beyond the current system, except those added by firm known investments. Given this, there are no new thermal units considered until 2020 despite the decommissioning of the largest coal power plant (in 2017). However, 1900 MW of new (already-licensed) large hydro power plants are assumed along with some development of renewable energy sources (185 MW), wind power included, and other non-renewable sources (120 MW).

Unavailable Capacity

Expected Non-Usable Capacity is obtained from probabilistic adequacy studies, accounting for the variability of Wind energy, Hydro and other non-dispatchable energy sources, such as thermal RES, CHP and Wastes.

Concerning Outages, the largest generation unit installed in the Portuguese system is assumed.

System Services Reserve is defined in order to face load forecast uncertainties and interconnection capacity forecast uncertainties.

Load

The energy consumption forecast is based on estimations enabling compliance with the revised ñNational Action Plan for The Energy Efficiencyò. This plan defines for the electric sector a total amount of savings of 5 % of consumption in 2015 and 10 % in 2020. No Load Management is assumed.

Generation Adequacy

In the calculation of the Adequacy Reference Margin (ARM), Spare Capacity results from probabilistic adequacy studies which account for load supply in 99 % of the situations. According to the last four years of demand data, Margin Against Seasonal Peak Load is assumed to be 6 % and 4 % of peak load on the 3rd Wednesday of January at 7 p.m. and the 3rd Wednesday of July at 11 a.m., respectively.

In every analyzed scenario, RC-ARM always remains positive.

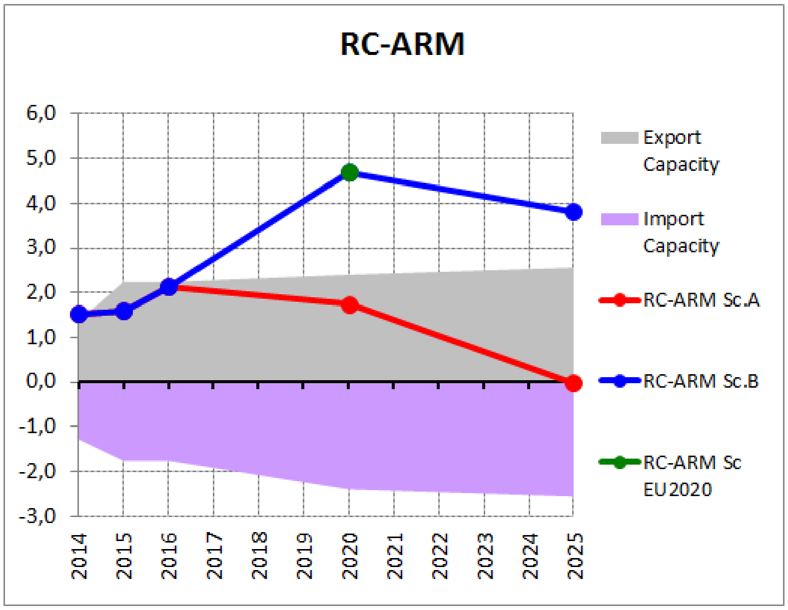
Interconnection Capacity

The Iberian Electricity Market (MIBEL) requires interconnection capacity in order to enable the required market energy exchanges, in both directions and with limited grid congestions.

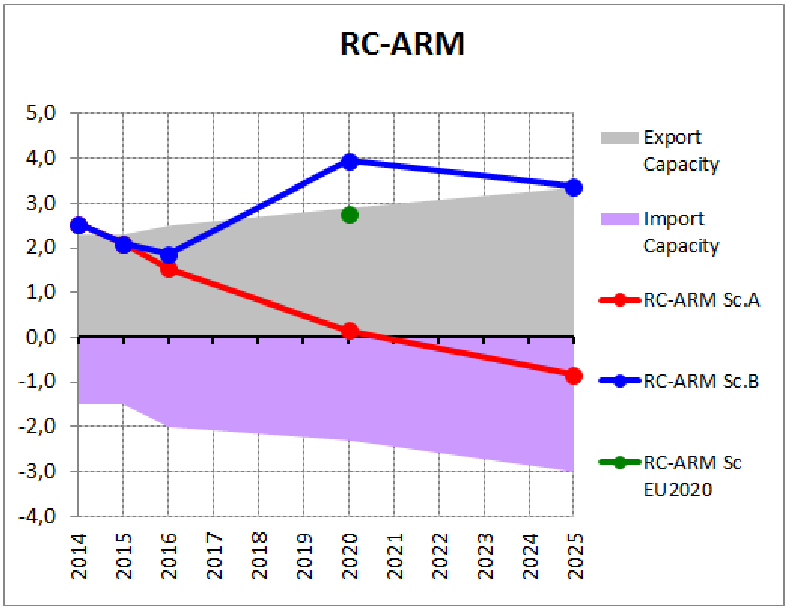
REN and REE have been developing several projects (internal reinforcements and interconnections), which have allowed for the improvement of the interconnection capacity between Portugal and Spain from 550 ï 850 MW in 2003 to 1,800 ï 2,000 MW in 2011.

Despite this great increase, significant congestion still exists. To overcome this congestion, several investment projects, including two new 400 kV interconnections, are in progress. REN and REE have a common goal, namely to increase the NTC value to a range of around 3,000 MW8).

The Iberian Peninsula has a very low interconnection exchange capacity with the rest of ENTSO-E. The reinforcement of the Spain-France interconnection will allow for an improvement of the quality and safety of supply, the growth of energy trade between the Iberian Peninsula and the rest of ENTSO-E. It will also allow for a greater and more efficient integration of renewable energy into the Iberian Peninsula system.

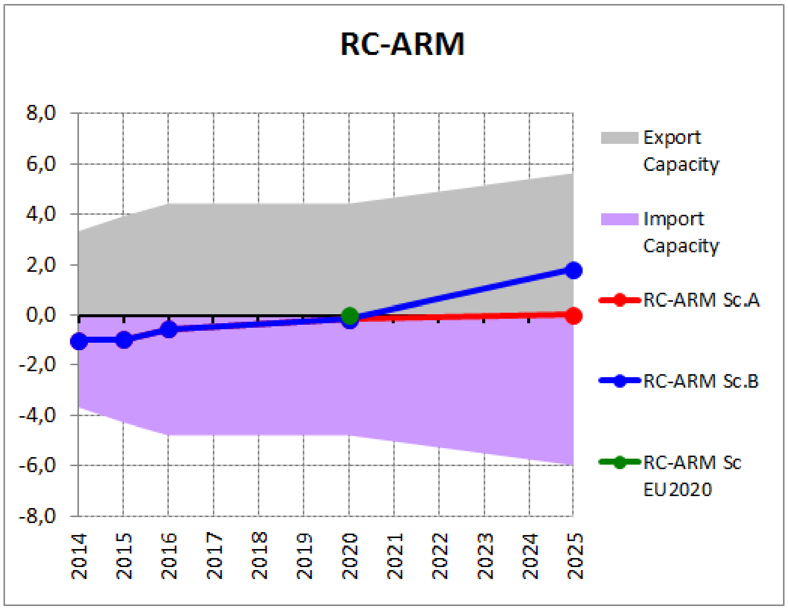


6.27 Romania

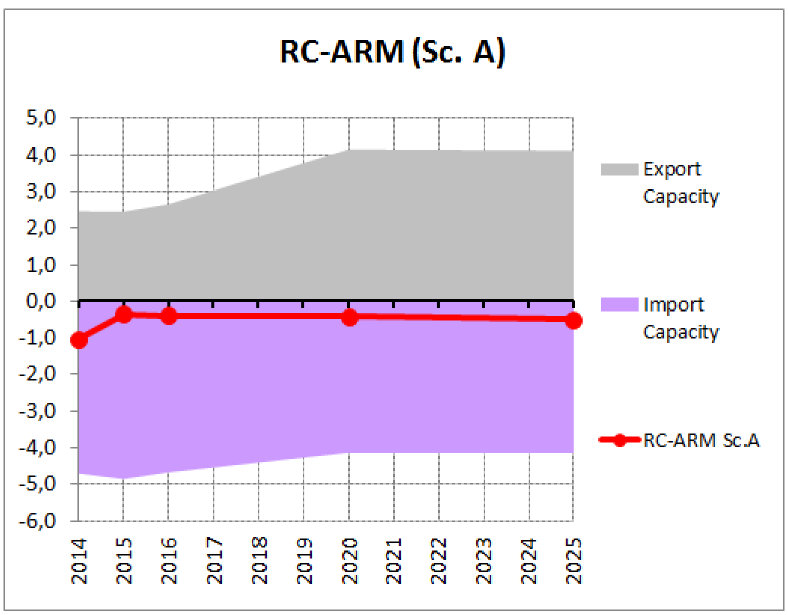


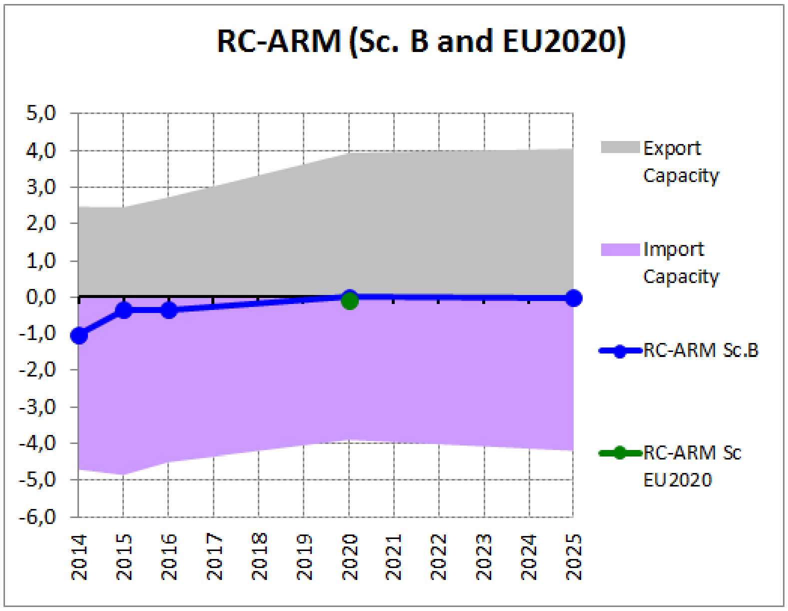
[8] For system adequacy purposes, Simultaneous Interconnection Transmission Capacity is based on 80 % of expected NTC between Portugal ï Spain.

6.28 **Serbia**

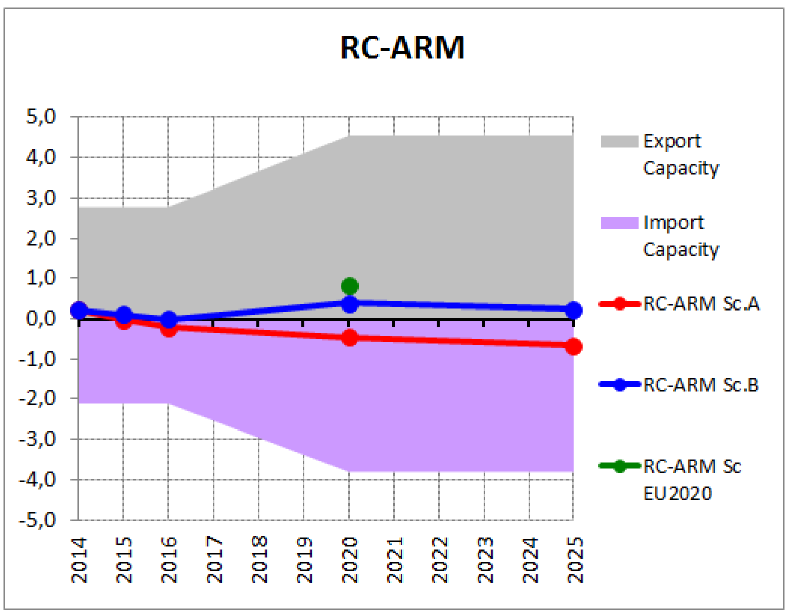


6.29 **Slovakia**





6.30 **Slovenia**



6.31 **Spain**

Definition of Scenarios

Best estimate scenario (2014-2025)

Over the last years electricity demand ceased to increase as a result of the effects of the global economic and financial crisis. The demand in 2013 is at 2005 level, and a significant increase is not foreseen in the short term.

In the long term, energy is expected to grow at a rate of 2% (y/y) in the best estimate scenario. The peak demand is expected to reach 55 GW in January 2025 under severe conditions, in the best estimate scenario.

The forecasted evolution of installed generation capacity in the peninsular Spanish electricity system up to 2025 is driven mainly by RES power, in particular solar and onshore wind. Some 3 GW of hydro units (mainly pumping hydro) are expected to be installed in the period up to 2025. Also, additional thermal units are expected to be installed shortly after 2020 in order to comply with adequacy standards (coverage index=1.1). Taking this into account the overall net generating capacity is forecasted to be 16% higher in 2025 than today.

In the data presented it is supposed that these additional units will be gas-fuelled but the decision on installing new power and the actual technology finally chosen will depend on the agents of the electricity market. It is worth to note that the actual decommissioning of coal power plants will depend on the application of the European Directive 2010/75/EU. Also, political decisions regarding the life extension of nuclear units will be very relevant in terms of adequacy especially beyond the 2020 horizon.

EU 2020 scenario (2020)

This scenario is defined based on the official Spanish NREAP. Given the recent regulatory changes regarding RES, the forecasted installed capacities for renewable energy in this scenario might be overestimated.

2030 Visions (2030)

Data for the 4 different ENTSO-E Visions are presented in this report. Firstly, Visions 1 and 3 are generated as a bottom-up view of the individual TSOs, following however a common framework given by the definition of these Visions.

- Vision 1: a conservative path is followed in terms of RES, together with a minimum growth in electricity demand.
-
- Vision 3: in this high RES scenario the installed wind power is expected to reach 49 GW in 2030, including some offshore facilities. Solar energy (both PV and CSP) is also expected to grow up to 37 GW in 2030. Along with the expansion of RES, backup technologies such as pumping and peak units will also increase. Regarding hydro generation, new pumping units are expected that will add a capacity of 3.8 GW when compared to 2020. These projects, along with the development of new interconnections, are of utter importance to effectively integrate the expected renewable power in the electrical system, which is a strategic objective for the System Operator and is in line with the energy policy objectives set by the European Commission.

Visions 2 and 4 are defined as top-down visions, taking into account that a common European effort is made in order to progress towards a truly unique European Market and to achieve the RES objectives. These visions are derived from Visions 1 and 3, respectively; apart from the pan-EU approach, these visions differ from the bottom-up visions in the sense that there is an increased electrification of the society (vg more electricity usages, electrification of transport), that and therefore electricity demand is higher than in the corresponding Visions 1 and 3.

- Vision 2: thanks to a more pan-EU vision of the European generation system, new interconnections will be built that will reduce the necessity of peak power plants when compared to Vision 1.
-

- Vision 4: there is a favourable socio-economic framework that, together with new electricity uses, makes this Vision to have the highest electricity demand. Since the high-RES objectives are reached in a pan-EU optimized context, a great amount of solar power is installed in Spain where insolation is high. Accordingly, new hydro pumping units are installed to cope with the variability of RES, and new international interconnection lines are built that will enable an integration of the Iberian Electricity Market in the European Electricity Market.

Generation adequacy

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.

Methodology

The methodology is described in the SOAF document. Regarding the calculation of non-usable capacity, these are the most important assumptions taken into account:

- Thermal forced outage rate: available thermal capacity with average 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 production exceeded with a probability of 90% has been considered.
- Solar PV power is considered unavailable in the winter peak. Solar CSP is considered partly available thanks to the contribution of heat storage in tanks of melted salts and the possibility of back-up with fuel.

Interconnection Capacity

The Iberian Peninsula has a very low interconnection ratio with France, which is currently of just 1.1% (import capacity with respect to installed capacity). The benefits of the development of the Spain-France interconnections include the improvement of the quality and safety of supply, the growth of energy trade between the Iberian Peninsula and the rest of ENTSO-E in both directions, as well as also allowing a greater and more efficient integration of renewable energy into the Iberian peninsular system.

The increase of the transmission capacity not only to France but also to Portugal, in the framework of the Iberian Electricity Market, is of great importance in terms of market integration and also regarding system adequacy and operational issues. Two new Spain-Portugal interconnections are expected to be commissioned before 2020 that will raise the NTC between Portugal and Spain to 3 GW.

A new interconnection line to France through the Eastern Pyrenees, whose commissioning is projected for 2014, will allow doubling the actual NTC between Spain and France (and hence with the rest of ENTSO-E system). In the longer term a new interconnection through the Biscay Gulf is under study and it is expected to be commissioned by the 2025 horizon; it would allow reaching the exchange capacity objective of 4 GW; however, this will not be sufficient to fulfil the 10% objective of the European Union.

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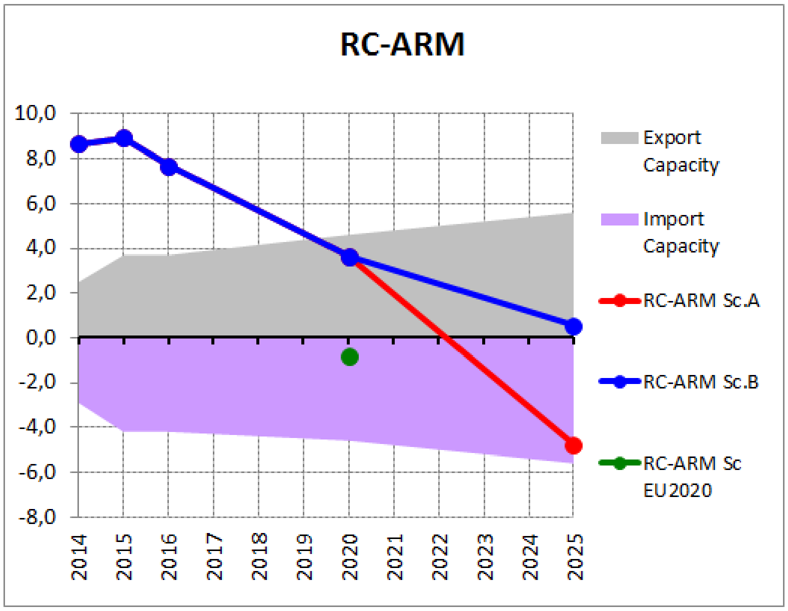
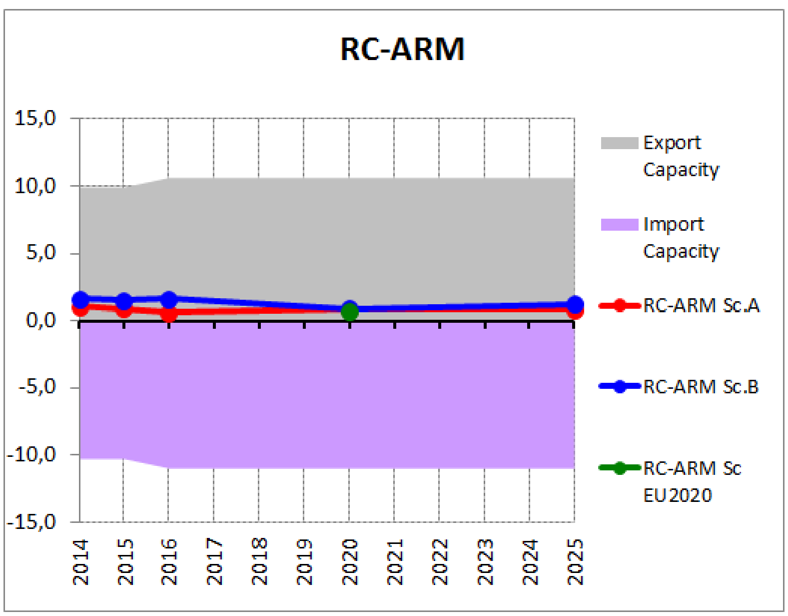
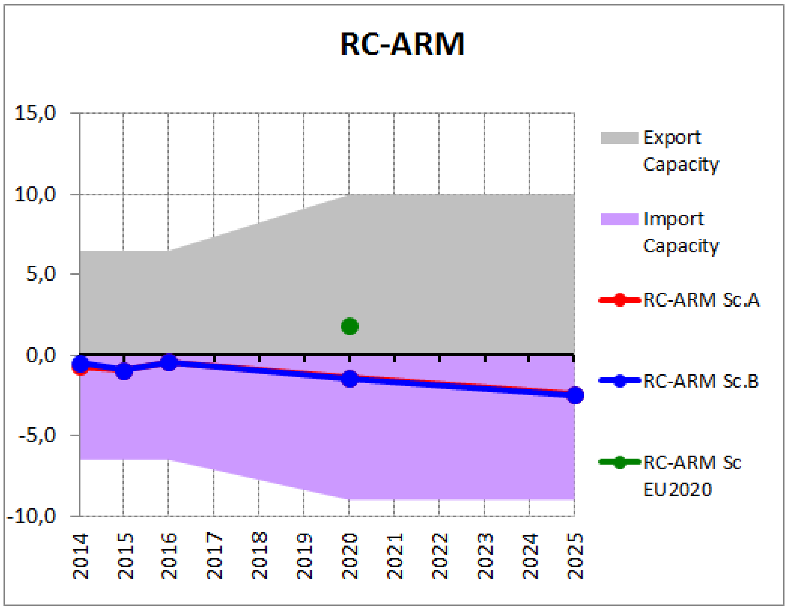

RC-ARM
10,0
8,0
6,0
4,0
2,0
0,0
-2,0
-4,0
-6,0
-8,0
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Export Capacity
Import Capacity
RC-ARM Sc.A
RC-ARM Sc.B
RC-ARM Sc EU2020

6.32 **Sweden**


RC-ARM
15,0
10,0
5,0
0,0
-5,0
-10,0
-15,0
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Export Capacity
Import Capacity
RC-ARM Sc.A
RC-ARM Sc.B
RC-ARM Sc EU2020

6.33 Switzerland



7. Methodology for Scenario Outlook and Adequacy Forecast

7.1 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 standard conditions. Within the ENTSO-E Scenario Outlook and Adequacy Forecast, system adequacy is assessed by means of Generation Adequacy Assessment.

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

7.2 Geographical Perimeter

System adequacy in ENTSO-E is analysed at 3 levels:

- individual ENTSO-E member countries;
- regional blocks;
- the whole ENTSO-E.

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Figure 7.1. ENTSO-E member countries

7.3 Forecast Scenarios

As long-term forecast is subject to a high level of uncertainty and considering that it can take several years to build only a new power plant, two bottom-up generation scenarios have been developed to help in assessing the range of uncertainty and evaluating the risk for the security of supply over the coming years.
Besides these scenarios, a scenario EU2020 compatible with the 3 x 20 objectives of the European Union (EU) has been developed, the purpose of which is to determine the generation outlook (renewable and conventional generation) which is necessary to reach the EU´s 2020 targets. Scenario EU2020 has therefore

been built on the top-down principle using National Renewable Energy Action Plans[9] (NREAP) as a reference for renewable energy sources and load determination. Fossil fuels´ forecast is envisaged to be built on the similar national documents reflecting the EU 2020 targets on the field of energy.

For the 2030 time horizon, due to the uncertainties of such long-term forecasts, a different approach is taken; data in this 2014 edition of SO&AF is collected for four distinctively different Visions, with the assumption that the actual future evolution of the assessed parameters shall safely lie between the pathways of the two visions.

Net Generating Capacity and the related primary energy sources breakdown as well as unavailable capacity are built in every country according to these generation scenarios.

Conservative Scenario or Scenario A

This bottom-up scenario shows the necessary additional investments in generation to be confirmed in the future. These are crucial in maintaining security of supply, if it is not already maintained.

This scenario takes into account the commissioning of new power plants considered as sure and whose commissioning decision can no longer be cancelled (power plants under construction before the data collection or whose investment decision has been notified as firm to the correspondent company).

As far as decommissioning is concerned, the most likely shutdown of power plants expected during the study period should be considered. Official notifications cannot be the only source for this estimation. Therefore, an assessment of decommissioning based on additional criteria such as technical lifetimes is recommended.

Load forecast in this scenario is the best national estimate available to the TSOs, under normal climatic conditions. It is estimated according to technical, economic and political assumptions, especially on demography, economic growth and energy efficiency policy. This scenario is not used to further specify grid development as part of the Ten Year Network Development Plan.

Best Estimate Scenario or Scenario B

This bottom-up scenario gives an estimation of potential future developments, provided that market signals give adequate incentives for investments.

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. Demands for grid connection by a producer cannot be the only source for this estimation. Therefore, an assessment of the likeliness of the projects, based on reasonable regional economic considerations of generation projects for instance, is expected in this scenario. Decommissioning and load should be treated as in Scenario A.

Disclaimer

Economic viability of existing and forecasted generation fleet, although important in order to assure an adequate level of security of supply, need detailed regulatory and market-design discussions which are outside the scope of the methodology used in this report.

In any case, whenever there is no official communication of decommissioning, it is generally considered that the units will be available for security of supply reasons. Simultaneously expected or officially announced investment in new generation capacities replacing decommissioning or non-economic operations has been taken into account without explicit consideration of the need for economic viability

[9] http://ec.europa.eu/energy/renewables/transparency_platform/action_plan_en.htm

EU2020 Scenario

This top-down scenario provides an estimation of potential future developments, provided that governmental targets set for renewable generating capacities in 2020 are met.

This scenario is derived from the EU policies on climate change and is based on national targets set in the NREAP[10] or equivalent governmental plan for renewable energy development if no NREAP applies. It takes into account the renewable generating capacities and electricity consumption mentioned in this plan.

A similar approach in the EU 2020 Scenario is taken as well as in the fossil fuels category meaning that respective national policies/documents dealing with the future of fossil fuels generating units in the views of the EU 2020 goals are taken into account. If no such documents are available, the best TSOsô estimation is requested.

This scenario is an important assumption to further specify grid development in the Ten Year Network Development Plan and does not impose any limitation with regard to further possible renewable energy generation development.

2030 Visions

The year 2030 is used as a bridge between the European energy targets for 2020 and 2050. The aim of the ñ2030 visions approachò should be that the pathway realized in the future falls with a high level of certainty in the range described by the visions detailed below.

The visions are not forecasts and there is no probability attached to the visions. There is also no adequacy analysis associated with them. These visions are based on previous ENTSO-E and regional market studies, public economic analyses and existing European documents.

This is a markedly different concept from that taken for the three scenarios until 2025, which aim to estimate the evolution of parameters under different assumptions, while the 2030 visions aim to estimate the extreme values, between which the evolution of parameters is foreseen to occur. This conceptual difference is also stressed by the different presentation on graphs throughout this report.

The two bottom-up (Visions 1 and 3) and the two top-down scenarios (Visions 2 and 4) are presented in this document, focusing on the extreme values of each parameter and explaining differences where appropriate. The values used for calculations are based on the Pan-European Market Modelling data used for TYNDP 2014; however, data was updated where deemed necessary due to changes since the PEMMDB data collection in Q4/2012.

[10] Values in the SO&AF report might differ slightly from the original ones in NREAP, after their refinement through the communication between the ministries and TSOs to define the data delivered in accordance with general guidelines. The modifications are needed for various reasons: Values in the SO&AF document refer to net generation and net consumption while those within the NREAP refer to gross values, NREAP is based on energy instead of power values, NREAP includes the whole country (including islands) while SO&AF may refer to mainland only, and so on.

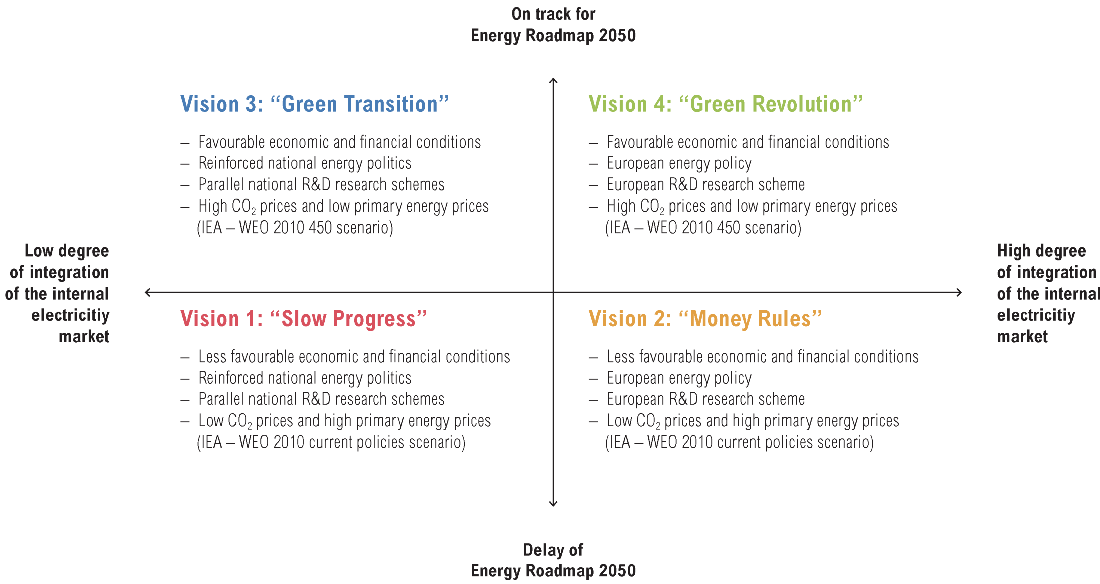

Figure 7.2.a: Overview of the political and economic frameworks of the four visions

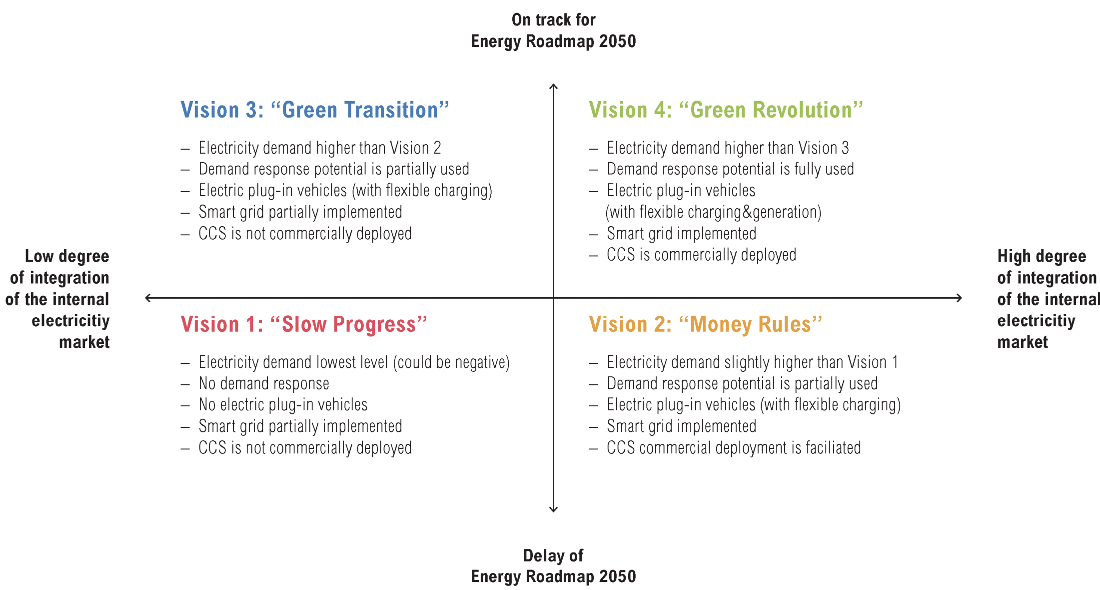

Figure 7.2.b: Overview of the generation and load frameworks of the four visions

Vision 1: "Slow progress"

Economic and Market

The general framework of this Vision 1 ñSlow progressò is that the economic and financial conditions are less favourable than in Visions 3 and 4 and, as a consequence, national governments have less money to reinforce existing energy policies. Furthermore, the absence of a strong European framework is a barrier to the introduction of fundamental new market designs that fully benefit from R&D developments. Moreover, the opting for parallel national schemes regarding R&D expenses also result in a situation where major technological breakthroughs are less likely due to suboptimal and repeated R&D spending.

Since no reinforcing of existing policies occurs, carbon pricing (e.g. the EU Emissions Trading System, carbon taxes or carbon price floors) remains at such a level that base load electricity production based on hard coal is preferred to gas. Carbon and primary energy prices could be based on the current policies scenario of the IEA in their WEO 2011. This means that countries with a lot of hard coal in their energy generation portfolio are likely to be net exporters.

Demand

There are no major breakthroughs in energy efficiency developments (e.g. large-scale deployment of micro-cogeneration or heat pumps as well as minimum requirements for new appliances and new buildings) due to a lack of regulatory push. There are also no major developments of the usage of electricity for transport (e.g. large-scale introduction of electric plug-in vehicles) and heating/cooling. As a consequence, electricity demand is expected to grow at a slower rate than in the other visions (e.g. the growth rate of electricity demand could be negative here). Furthermore, no effort is made, through an adaption of the market design, to use the demand response potential that would allow partially shifting the daily load in response to the available supply.

Generation

The future generation mix is determined by national policy schemes that are established without coordination at a European level. Due to a lack of financial resources and construction delays due to permitting issues, the generation mix in 2030 fails to be on track for the realization of the energy roadmap 2050. If the energy objectives 2020 were only realized in 2030, the need for additional back-up capacity[11] in 2030 would then remain at the same order of magnitude as that currently estimated for 2020. This back-up capacity is likely to come from gas units, since demand response potential and additional hydro storage are not significantly developed in this vision. However, due to the limited size of the back-up capacity, the need for flexible base load capacity remains reasonable and it is not likely that gas will push out hard coal for base load electricity generation.

This vision also takes into account a growing public opposition to nuclear, despite it being a low-carbon technology, in the aftermath of the Fukushima Daiichi nuclear disaster. Nevertheless, the vision permits deviations if this is in line with the current national view. In general, it is assumed that the financial community maintains its refusal to invest in this technology on a merchant basis and that technology-specific support schemes are not likely. The less favourable economic and financial conditions also result in the assumption that commercial deployments of Carbon Capture and Storage (CCS) infrastructure beyond the planned demonstration plants are not realistic.

Grid

Distribution grid and transmission systems connected as today. There is a certain amount of price-elastic demand and smart communication enabling distributed resources to balance the RES fluctuation. However, it is assumed that this does not fundamentally change the load pattern. The impact of electric vehicles is also assumed to be negligible in this Vision (no commercial breakthrough of vehicles to grid connections).

Vision 2: "Money rules"

[11] Besides the need for back-up capacity, other criteria also need to be taken into consideration when assessing how much dispatchable thermal generation should be assumed in a particular visions, e.g. the yield of return based on a combination of running hours at full load and price mark ups allowing capital recovery.

Economic and market

The general framework of this Vision 2 ñMoney rulesò is that the economic and financial conditions are less favourable than in Visions 3 and 4 and as a consequence national governments have less money to reinforce existing energy policies. However there is a strong European framework but due to the economic and financial outlook the introduction of fundamental new market designs and R&D expenses focuses on cost cutting and not the goals of the Energy Roadmap 2050.

Since no reinforcing of existing policies occurs carbon pricing (e.g. the EU Emissions Trading System, carbon taxes or carbon price floors) remains at such a level that baseload electricity production based on hard coal is preferred to gas. Carbon and primary energy prices will be based on the current policies scenario of the IEA in their WEO 2011. This means that countries with a lot of hard coal in their energy generation portfolio are likely to be net exporters.

Demand

The breakthrough in energy efficiency developments (e.g. large scale deployment of micro-cogeneration or heat pumps as well as minimum requirements for new appliances and new buildings) and the development of the usage of electricity for transport (e.g. large scale introduction of electric plug-in vehicles) and heating/cooling focus on possible economic benefits. As a consequence the electricity demand is expected to grow at a higher pace than in vision 1 ñSlow progressò due to the fact that the introduction of these new uses of electricity more than compensates the realized energy efficiency improvements. Furthermore, the demand response potential is partially used to shift the daily load in response to the available supply, because it allows a saving on back-up capacity and it is cheaper than storage.

Generation

The future generation mix is determined by a strong European vision that faces a lack of financial resources and construction delays due to permitting issues that result in a delay in the pathway to realization of the energy roadmap 2050. If the energy objectives 2020 are only realized in 2030 than the need for additional back up capacity in 2030 would remain at the same order of magnitude as that currently estimated for 2020. Since there is a European common energy framework the need for back-up capacity will be lower than in vision 1 ñSlow progressò and this back-up capacity is likely to come from demand response as much as possible since it is cheaper than building additional gas units or storage. In this vision we can assume 50% of the maximum demand response capacity of 10% is used. This vision takes into account that no technology is preferred and that they compete with each other on a market basis with no specific support measure. Furthermore, decarbonisation is only driven by carbon pricing (no additional policies are assumed if carbon prices are too low to ensure a lower usage of coal fired units) and an assumption of public acceptance of nuclear. The European subsidies for the demonstration of CCS at full-scale are intensified in order to speed up the successful commercial deployment of CCS infrastructure.

Grid

Distribution grids and transmission systems connected by an advanced monitoring, control and communication link. Distribution grids become active [bidirectional electricity flows]. The option of a potential bidirectional energy exchange with the grid (ñvehicle-to-gridò or V2G approach) for electric vehicles is partially developed. Electric vehicles are assumed to be flexible on charging side. Load is partially adapting to generation possibilities.

Vision 3: “Green transition”

Economic and market

The general framework of this Vision 3 ñGreen transitionò is that the economic and financial conditions are more favourable than in Visions 1 and 2 and, as a consequence, national governments have money to reinforce existing energy policies. However, the absence of a strong European framework is a barrier to the introduction of fundamental new market designs that fully benefit from R&D developments. Furthermore, the opting for parallel national schemes regarding R&D expenses also result in a situation where major technological breakthroughs are less likely due to suboptimal and repeated R&D spending.

Since there is a reinforcing of existing energy policies, carbon pricing (e.g. the EU Emissions Trading System, carbon taxes or carbon price floors) reaches such levels that base load electricity production based on gas is preferred to hard coal. Carbon and primary energy prices could be based on the 450 scenario of the IEA in their WEO 2011. Gas is likely to push out hard coal for base load electricity generation. This means that countries with a lot of gas in their energy portfolio are likely to be net exporters.

Demand

Efforts in energy efficiency developments (e.g. large-scale deployment of micro-cogeneration or heat pumps as well as minimum requirements for new appliances and new buildings) and the development of the usage of electricity for transport (e.g. large-scale introduction of electric plug-in vehicles) and heating/cooling are intensified to minimize the ecological footprint. However, these are developed in the current market frameworks. As a consequence, electricity demand is expected to grow at a higher pace than in Vision 1 ñSlow progressò and Vision 2 ñMoney rulesò, due to the fact that the introduction of these new uses of electricity more than compensates for the realized energy efficiency improvements and is intensified through additional subsidies. Furthermore, the demand response potential is partially used to shift the daily load in response to the available supply, because it allows a saving on back-up capacity and it is cheaper than storage.

Generation

The future generation mix is determined by parallel national policy schemes that are on track to realize the decarbonisation objectives for 2050. However, it will be at a higher cost than it would be in the case of a strong European framework, since more back-up capacity is needed. The need for back-up capacity for intermitted renewable energy sources in Europe could be substantially more than the back-up capacity[12] needed for the realization of 3x20 objectives. This means that although demand response potential is used (50% due to no fundamental change in market design), the majority of the additional back-up capacity in 2030 would come from gas units, since additional ways of central hydro storage are not developed due to a lack of a strong European framework. This vision also takes into account the growing public opposition to nuclear power, although it is a low-carbon technology, influenced by the aftermath of the Fukushima Daiichi nuclear disaster. Although the vision permits deviations if this is in line with the current national view, it is assumed that the financial community generally maintains its refusal to invest in nuclear technology on a merchant basis and that technology-specific support schemes are not likely. The absence of a strong European framework results in the assumption that commercial deployment of CCS infrastructure beyond the planned demonstration plants is not realistic.

Grid

Distribution grid and transmission system connected as today. There is a certain amount of price-elastic demand and smart communication, enabling distributed resources to balance the RES fluctuation. However, it is assumed that this does not fundamentally change the height of the daily peak. The impact of electric vehicles is an augmentation of the load during off-peak hours.

Vision 4: "Green revolution"

Economic and market

[12] ñPower Perspectives 2030: on the road to a decarburization power sectorò, European Climate Foundation (2011) mentions 5 times more back-up capacity (http://www.roadmap2050.eu/attachments/files/PowerPerspectives2030_FullReport.pdf).

The general framework of this Vision 4 ñGreen revolutionò is that the economic and financial conditions are more favourable than in Visions 1 and 2 and as a consequence national governments have money to reinforce existing energy policies. Major investments in sustainable energy generation are undertaken. Furthermore, a strong European framework makes the introduction of fundamental new market designs that fully benefit from R&D developments more likely. This also allows R&D expenses to be optimized so that major technological breakthroughs are more likely.

Since there is a reinforcing of existing energy policies carbon pricing (e.g. the EU Emissions Trading System, carbon taxes or carbon price floors) reaches such levels that baseload electricity production based on gas is preferred to hard coal. Carbon and primary energy prices will be based on the 450 scenario of the IEA in their WEO 2011. Gas is likely to push out hard coal for baseload electricity generation. This means that countries with a lot of gas in their energy portfolio are likely to be net exporters.

Demand

Efforts in energy efficiency developments (e.g. large scale deployment of micro-cogeneration or heat pumps as well as minimum requirements for new appliances and new buildings) and the developments of the usage of electricity for transport (e.g. large scale introduction of electric plug-in vehicles) and heating/cooling are intensified. Furthermore market designs are adapted in such a way that the highest energy savings are combined with the highest substitution to electricity. As a consequence electricity demand is expected to grow at higher pace than in Vision 3 ñGreen energyò due to the fact that the introduction of these new uses of electricity more than compensates the realized energy efficiency improvements. These new usages are intensified through additional subsidies. Furthermore the demand response potential is fully used to shift the daily load in response to the available supply, because it allows a saving on back-up capacity and it is cheaper than storage.

Generation

The future generation mix is determined by a strong European vision that is on track to realize the decarbonisation objectives for 2050 at least cost. The need for back-up capacity for intermitted renewables in Europe could be substantially more than the back-up capacity needed for the realization of 3x20 objectives. However since there is a European common energy framework the need for back-up capacity will be lower than in Vision 3 ñGreen transitionò. This means that besides the demand response potential that is fully used, central additional hydro storage is built in Scandinavia, the Alps and the Pyrenees and the remaining additional back up capacity in 2030 will come from gas units. This vision takes into account that no technology is preferred and that they compete with each other on a market basis with no specific support measure. Furthermore decarbonisation is only driven by carbon pricing (no additional policies on top of carbon pricing are assumed) and assuming public acceptance of nuclear. The European subsidies for CCS to develop beyond demonstration are intensified in order to speed up to successful commercial deployment.

Grid

Distribution grids and transmission systems connected by an advanced monitoring, control and communication link. Distribution grids become active [bidirectional electricity flows]. That configuration allows increased reliability, efficient management of peak demand. Furthermore, the configuration reduces required back-up generation capacity, increases environmental sustainability and reduces CO2 emissions, fully accomplishing requirements of the Roadmap 2050 milestones. The option of a potential bidirectional energy exchange with the grid (ñvehicle-to-gridò or V2G approach) for electric vehicles is fully developed. Electric vehicles are assumed to be flexible on charging and generation side. Load is adapting to generation possibilities.

7.4 Data Definitions

Adequacy Reference Margin: The part of Net Generating Capacity that should be kept available at all times to ensure the security of supply on the whole period each reference point is representative of.

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

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

Maintenance and Overhauls: This category aggregates scheduled unavailability of generating capacity for regular inspection and maintenance.

Margin against Seasonal Peak Load: The difference between Load at the reference point and the Peak Load over the season (summer or winter) the reference point is representative of. It serves to extend the results from the single reference point to the whole investigated period.

Net Generating Capacity (NGC): The Net Generating Capacity of a power station is the maximum electrical net Active Power it can produce continuously throughout a long period of operation in normal conditions. òNetò means the difference between, on the one hand, the gross generating capacity of the alternator(s) and, on the other hand, the auxiliary equipment load and the losses in the main transformers of the power station.

> Remark: If the lowest voltage levels are not considered for load which is net of generation on these voltage levels, then the generation connected to these lowest voltage levels should not be reported. In this respect, the National Representativeness index is the estimation of the percentage of the national value which the collected data are representative of. As generation adequacy is based on the comparison of national load and generation, National Representativeness of load data and generation data should be identical in order to make the generation adequacy assessment reliable.

Remark: The National Generating Capacity of a country is the sum of the individual Net Generating Capacity of all power stations connected to either the transmission grid or the distribution grid. Sum of the individual net generating capacity of all power stations connected to either transmission or the distribution grid;

Non-usable capacity: Aggregated reduction of the net generating capacities due to various causes, including, but not limited to

- Limitation due to intentional decision by the power plant operators
  - Power stations in mothball which may be re-commissioned if necessary
  - Power stations bound by local authorities which are not available for interconnected operation
  - Power stations under construction whose commissioning is scheduled for a certain date, but capacity is not firmly available because of delays or retrofitting
  - Power stations which are converted to other fuels or which are equipped subsequently with desulphurization and de-nitrification plants
  - Power stations in test operation
- Unintentional temporary limitation
  - Power stations whose output power cannot be fully injected due to transmission constraints
  - Power station in multiple purpose installations where the electrical generating capacity is reduced in favour of other purposes such as heat extraction in combined heat and power plants for instance
- Temporary limitation due to constraints, like power stations in mothball or test operation, heat extraction for CHPs
- Limitation due to fuel constraints management
  - Nuclear power stations in stretch-out operation
  - Fossil fuel power stations
    - Power stations with interruptible fuel supply
    - Power stations with poor quality fuel, like unfit coal
-

- Limitation reflecting the average availability of the primary energy source
  - Hydro power stations
    - Run-of-river power stations with usual seasonal low upstream water flow
    - Tidal power stations
    - Storage power stations subject to usual limitation such as limited reservoir capacity, power losses due to high water, loss of head height or limitation of the downstream water flow
  - Wind power stations;
  - Photovoltaic power stations;
  - Geothermal power stations,
- Power stations with output power limitation due to environmental and ambient constraints
- Limitation due to other external constraints
  - Hydro power stations with water flow regulation for irrigation, navigation, tourism
  - Power stations with output power limitation due to environmental constraints
  - Power stations with output power limitation due to external thermal conditions

7.4.1.1 **Outages:** This category aggregates forced ï that is, not scheduled - unavailability of generating capacity.

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

- Data collected for the hour H are the average value from the hour H-1 to the hour H.
- 2 annual reference points are defined in the SO&AF report:
- The 3rd Wednesday of January on the 19th hour (from 18:00 CET to 19:00 CET)
- The 3rd Wednesday of July on the 11th hour (from 10:00 CEST to 11:00 CEST)

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

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

Simultaneous exportable/importable capacity: Transmission capacity available for exports/imports to/from other Control Areas.

Remark: It is calculated taking into account the mutual dependence of flows on different profiles due to internal or external network constraints and may therefore differ from the sum of NTCs on each profile of a Control Area or country. SITC values are potentially different at every reference points on all time horizons;

Spare Capacity: The spare capacity reflects the additional capacity which should be available on a power system to cope with any unforeseen extreme conditions. It comes in addition to system services reserves and margin against seasonal peak load.

> Remark: Spare Capacity should be sufficient to cover a 1% risk of shortfall on a power system, that is, to guarantee the operation on 99% of the situations considering random fluctuations of Load and the availability of generation units. Since load/supply severe conditions of individual countries are not likely to occur at the same day and time, Spare Capacity for a set of countries (regional blocks or whole ENTSO-E) will be expressed in the SO&AF report as 5% of Net Generating Capacity.

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

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

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Unavailable Capacity: The part of Net Generating Capacity which is not reliably available to power plant operators due to limitations of the output power of power plants. Although a power station can theoretically generate electricity from its total installed power, this is not actually the case in real life for the several causes, some of which are listed below.

7.5 Scenario Outlook Methodology

Further to an extensive presentation of the generating capacities, consumption and load in the 3 scenarios plus the bottom-up national 2030 visions with emphasis on the most significant figures, comparisons could be made between these scenarios.

When comparing Scenario B to Scenario EU2020, the difference is shown between the amount of investments considered as likely by the TSO based on known projects, with the investments needed to meet political targets for development of renewable energy according to the National Renewable Energy Action Plan or equivalent governmental plan.

When comparing Scenario B to Scenario A, the idea is to show the difference in generation investments which have already been decided, with the amount of investments that is considered as likely and needed by the TSO.

7.6 Adequacy Forecast Methodology

Power Balance

Power balance calculations concern specific time points and various perimeters, and aim to assess adequacy referring to the following indicators:

- Reliably Available Capacity (RAC)
- Remaining Capacity (RC)
- Adequacy Reference Margin (ARM)

The relation between these three parameters is illustrated in the figure below.

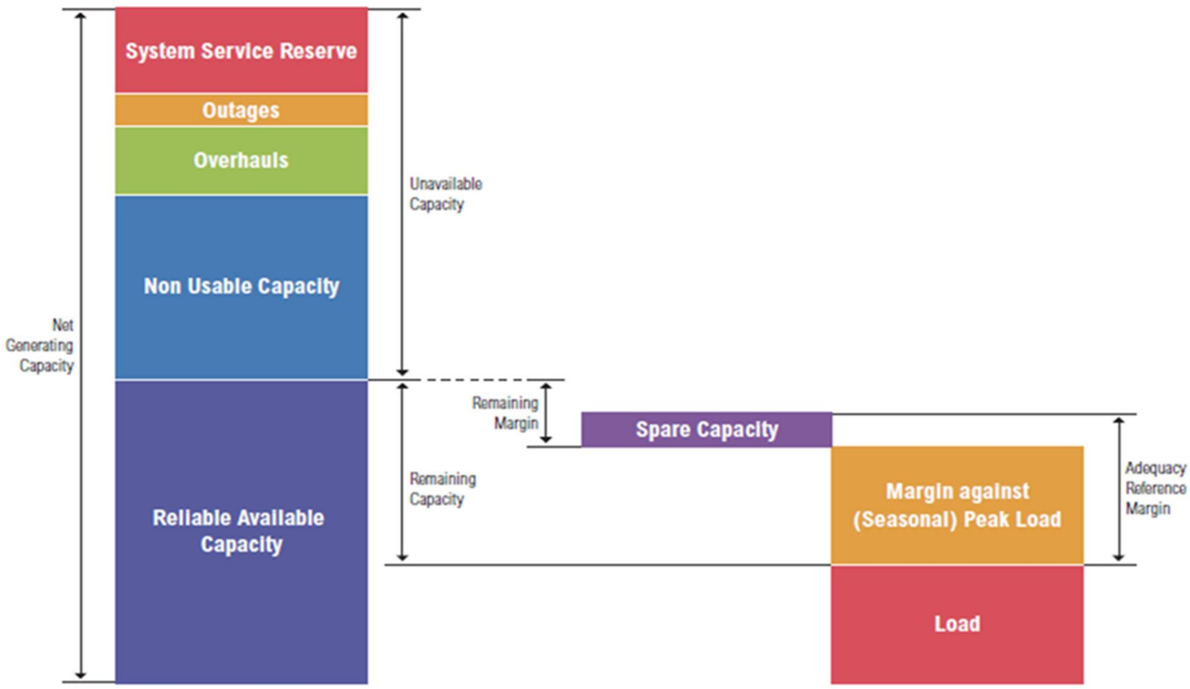

Figure 7.3: Schematic depiction of adequacy methodology

Reliably Available Capacity

Reliably Available Capacity on a power system is the difference between Net Generating Capacity and Unavailable Capacity.
Unavailable Capacity is the part of Net Generating Capacity that is not reliably available to power plant operators due to limitations of the output power of power plants. It is calculated by adding Non-Usable Capacity, Maintenance and Overhauls, Outages and System Services Reserves.

Reliably Available Capacity = Net Generating Capacity – Unavailable Capacity

Reliably Available Capacity is the part of Net Generating Capacity which is actually available in the power system to cover the load at a respective Reference Point in normal (average) conditions.

Remaining Capacity

Remaining Capacity on a power system is the difference between Reliably Available Capacity and Load at reference point.

Remaining Capacity = Reliably Available Capacity – (Load – Load Management)

Remaining Capacity is the part of Net Generating Capacity left on the power system to cover any unexpected load variation and unplanned outages at a Reference Point and in normal (average) conditions.
Remaining Capacity is calculated in the SO&AF report including Load Management, which increases the amount of Remaining Capacity.

Adequacy Reference Margin

Adequacy Reference Margin is the part of Net Generating Capacity that should be kept available at all times to ensure the security of supply on the whole period each reference point is representative of. It serves to assess generation adequacy in most of the situations.

Adequacy Reference Margin in an individual country is equal to the sum of the Spare Capacity and the Margin against Seasonal Peak Load.

Adequacy Reference Margin = Spare Capacity + Margin against Seasonal Peak Load

Adequacy Reference Margin in a set of countries (i.e. regional blocks or the whole ENTSO-E) is estimated as the sum of the two following terms:

- Sum of all individual Margin against Seasonal Peak Load values ($\sum_{i=1}^{n} MaSPL_{IC}$). As peak loads are not synchronous in all countries, this sum is overestimating the actual Margin against Seasonal Peak Load of the set of countries.
- Spare Capacity of the set of countries ($0.05 \times \sum_{i=1}^{n} NGC_{IC}$). This is estimated as 5% of Net Generating Capacity of the set of countries. For this reason, Spare Capacity of the set of countries may be different from the sum of all individual Spare Capacity values.

Adequacy Reference margin for a set of countries is then given by following formula:

$$\mathrm{ARM}_{SC} = \sum_{i=1}^{n} \mathrm{MaSPL}_{IC} + 0.05 \times \sum_{i=1}^{n} \mathrm{NGC}_{IC}$$

n is the total number of countries within the block of countries for which ARM is calculated;

SC is the abbreviation for "Set of Countries";

IC is the abbreviation for "Individual Country".

Generation Adequacy

Generation adequacy is assessed for each of the individual countries, for regional block(s) identified within the ENTSO-E system and for the whole ENTSO-E.

Messages deriving from the assessment of generation adequacy may differ depending on the Scenario that is under analysis. For "Conservative" Scenario A, the actual need for additional investments in generation power is identified (or just the need for confirmation of projects that are not yet firmly engaged). Regarding "Best-Estimate" Scenario B, it is indicated how adequate investments are expected to be from an ENTSO-E point of view. A similar assessment for the EU 2020 scenario is conducted to establish whether the 202020-objectives and generation adequacy are compatible.

Generation adequacy forecast on power systems is assessed at the reference points through the Remaining Capacity value which is calculated under normal conditions.

When Remaining Capacity is positive, it means that excess generating capacity is available in the power system under normal conditions.

When Remaining Capacity is negative, it means that the power system is short of generating capacity under normal conditions. Generally, this shall be interpreted as a potential deficit of generating capacity on power systems if no investments in additional generating units are decided from now on until the analysed time horizon.

If the absolute value of a negative Remaining Capacity is lower than Import Capacity, it is likely that the full amount necessary to meet load can be imported. However, on the contrary (absolute value of negative) Remaining Capacity being higher than Import Capacity does not necessarily call for additional transmission capacities, as many uncertainties are present to size the adequate import capacity. These are not considered within this report, but within Regional Investment Plans and the Ten Year Network Development Plan.

These assessments are applicable to individual countries, regional blocks and the whole ENTSO-E.

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Seasonal Generation Adequacy Forecast in most of the situations

Generation adequacy forecast on power systems is then extended to comprehend seasonal peak load as well as the occurrence of severe conditions. This is achieved through the comparison of Remaining Capacity and Adequacy Reference Margin.

When Remaining Capacity is equal to or higher than Adequacy Reference Margin, security of supply of power systems is likely to be guaranteed in most of the situations. Some of the excess generation capacity is likely to be exportable to other systems, even when severe conditions on both demand and supply sides occur.

When Remaining Capacity is lower than Adequacy Reference Margin, it means that the power system is likely to be relying on imports when facing seasonal peak load and/or severe conditions. Generally, this shall be interpreted as a potential deficit of generating capacity on power systems if no investments in additional generating units are decided from now until the analysed time horizon.

The (absolute value of) Remaining Capacity minus Adequacy Reference Margin being higher than Import Capacity does not necessarily call for additional transmission capacities, as many uncertainties are present in sizing the adequate import capacity. These are not considered within this report, but within Regional Investment Plans and the Ten Year Network Development Plan.

When assessing the generation adequacy of regional blocks or whole ENTSO-E, a comparison made between Remaining Capacity and Adequacy Reference Margin still provides indications about potential surplus/deficits of regional blocks and whole ENTSO-E, as well as further eventual needs to additional investments in generating assets.

Regional analysis

As a new approach towards the intermediate level of adequacy assessment (i.e. between the national and pan-European level), a simplified optimisation study is carried out, identifying possible groups of countries relying on imports, instead of splitting the system according to the ENTSO-E regional groups. This new philosophy allows for a better identification and assessment of bottlenecks in the system, since the group(s) of countries analysed are chosen based on actual calculation results instead of forming regional groups first and performing regional assessment within the pre-defined country sets.

The above mentioned optimisation study is based on the Remaining Capacity reduced by Spare Capacity. Note that Margin against seasonal peak load is not taken into account in these calculations, as the peak load does not occur simultaneously in all countries. The optimisation attempts to cover the necessary import of all countries that have a negative RC-SC value, from those having a surplus of generation (positive RC-SC). During the calculation, sum of cross-border flows is minimised, thus showing whether the required simultaneous imports of neighbouring countries are physically feasible and there is sufficient surplus available in other countries. This approach does not take into account market conditions. Both simultaneous and per-border transfer capacities (as in SO&AF and PEMMDB data entered by national correspondents, respectively) are observed in the calculation as boundary conditions.

The regional analysis is based on both reference points, data of Scenario B.

The results of the assessment and further details and explanations on the identified group(s) of countries requiring simultaneous imports are provided in paragraph 4.2.

7.7 Other important facts/information

All input data for this report have been provided by the TSOs (and their respective correspondent), on a national basis, for the years 2014, 2015, 2016, 2020, 2025 and 2030 (depending on the scenario, see table below). Any other years depicted in graphs or shown in figures are calculated as linear extrapolation and are only estimations. The Data collection process was run in Q1/2014.

Data collected	2014	2015	2016	2020	2025	2030
Scenario A	x	x	x	x	x	
Scenario B	x	x	x	x	x	
Scenario EU20				x		
Vision 1						x
Vision 2						x
Vision 3						x
Vision 4						x

Furthermore, data provided for the time period after the year 2020 should be considered as having quite a high level of uncertainty. It is caused by data availability/unavailability to the respective TSO, along with the fact that a lot of different national policies do not cover such a long-term period, etc. Therefore, a different approach is taken for the 2030 data, as explained in the Methodology section.

Data have been provided for the three scenarios of generating capacity evolution (for more information see methodology document) and for two reference points: 3rd Wednesday of January 7 p.m. (for winter) and 3rd Wednesday of July 11 a.m. (for summer).

Values used in calculations are rounded to two decimal places (for subcategories).

Calculations and comparisons used in the SO&AF 2014 to characterize the reliability of a power system are calculated mainly for the third Wednesday in January at 7 p.m. for Scenario B and Scenario EU 2020, unless otherwise indicated.

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