European Network of
Transmission System Operators
for Electricity

ENTSO-E
Methodology for
System Adequacy Retrospect

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1 INTRODUCTION

1.1 PURPOSE OF THIS DOCUMENT

This document aims at describing the data and the methodology for system adequacy analysis used by ENTSO-E in its System Adequacy Retrospect report.

The ENTSO-E System Adequacy Retrospect report aims at providing stakeholders in the European electricity market with an overview of generation, demand and their adequacy in the ENTSO-E Power System, with a focus on the power balance, margins and the generation mix.

1.2 SYSTEM ADEQUACY

System adequacy of a power system is a measure of the ability of a power system to supply the load in all the steady states in which the power system may exist considering standards conditions. Within the ENTSO-E System Adequacy Retrospect, System Adequacy is assessed by means of Generation Adequacy.

Generation adequacy of a power system is an assessment of the ability of the generation on the power system to match the consumption on the power system. The methodology for generation adequacy analysis is introduced in Chapter **Error! Reference source not found.**.

1.3 GEOGRAPHICAL PERIMETER

System adequacy is analysed at 3 levels: individual countries, regional blocks and the whole ENTSO-E.

The following regional blocks can be distinguished:
NORTH SEA:
Belgium (BE), Denmark (DK), France (FR), Germany (DE), Great Britain (GB), Luxembourg (LU), the Netherlands (NL), Northern Ireland (NI), Norway (NO) and the Republic of Ireland (IE)
BALTIC SEA:
Denmark (DK), Estonia (EE), Finland (FI), Germany (DE), Latvia (LV), Lithuania (LT), Norway (NO), Poland (PL) and Sweden (SE).
CONTINENTAL SOUTH WEST:
France (FR), Portugal (PT) and Spain (ES).
CONTINENTAL SOUTH EAST:
Bosnia-Herzegovina (BA), Bulgaria (BG), Croatia (HR),
Former Yugoslav Republic of Macedonia (MK), Greece (GR), Hungary (HU), Italy (IT),
Montenegro (ME), Republic of Serbia (RS), Romania (RO) and Slovenia (SI).
CONTINENTAL CENTRE SOUTH:
Austria (AT), France (FR), Germany (DE), Italy (IT),
Slovenia (SI) and Switzerland (CH);
CONTINENTAL CENTRE EAST:

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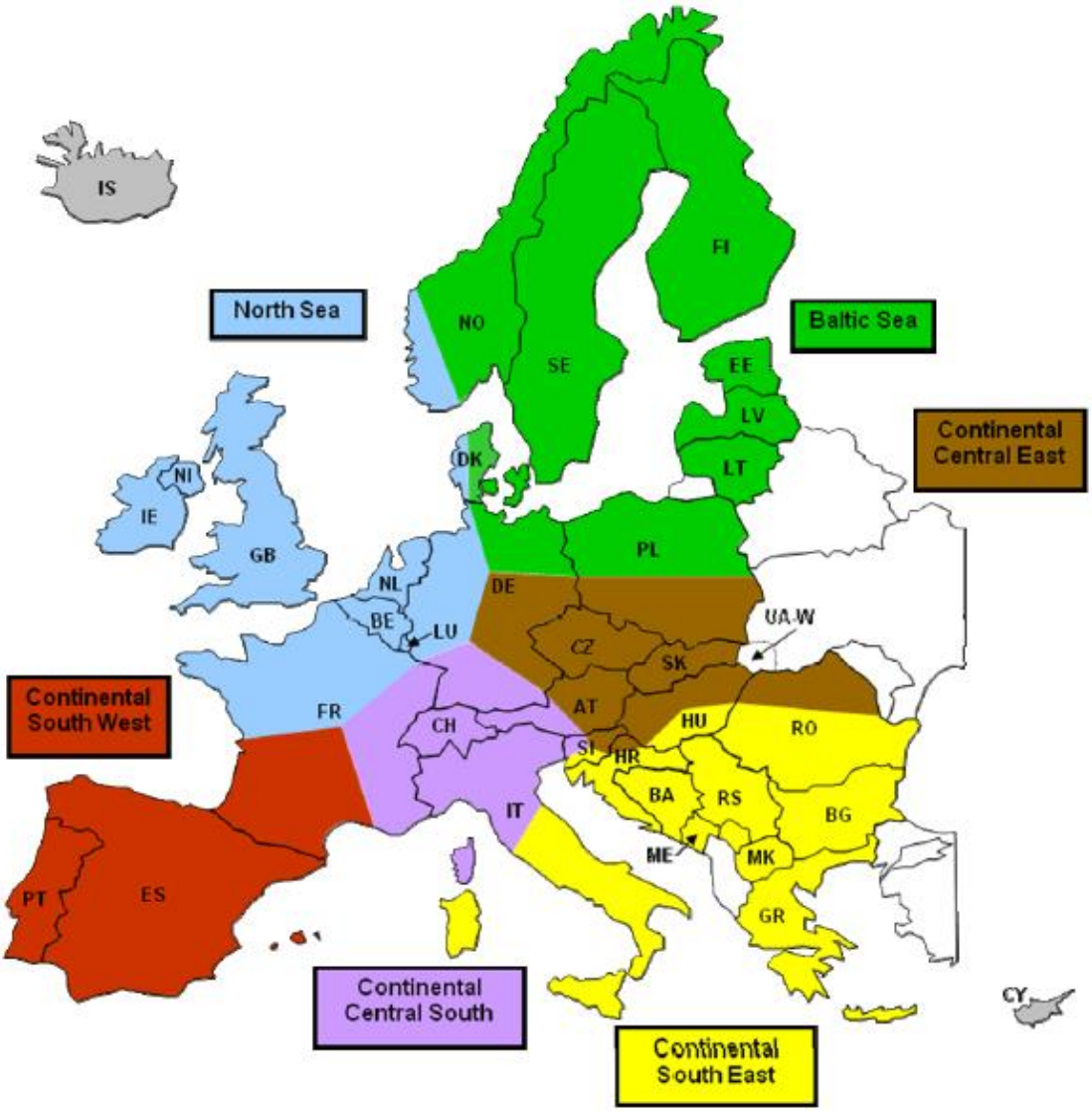
Austria (AT), Croatia (HR), Czech Republic (CZ), Germany (DE), Hungary (HU), Poland (PL), Romania (RO), Slovak Republic (SK) and Slovenia (SI).

In addition to these regions and countries listed above, analyses are reported on some other countries/control areas:
ISOLATED SYSTEMS:
Cyprus (CY), Iceland (IS)
ADDITIONAL CONTRIBUTING CONTROL AREAS:
Ukraine West (UA-W)

All above mentioned regions are depicted on the figure below.



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2 METHODOLOGY

2.1 DATA DEFINITION

2.1.1 ENERGY AND POWER DATA

For System Adequacy Retrospect purposes, total annual energies and power data for a single hour on a monthly basis are collected.

A matching set for supply and demand data will be collected.

Some data to be collected for System Adequacy Retrospect are also collected for the monthly statistics. Correspondents have then the possibility to automatically take over these values if the perimeters match (e.g. voltage levels). In case the values are no longer valid, monthly statistics should be updated.

To both Energy and Power data, the National Representativeness index is applied. This index is the estimated percentage of the national value the collected data are representative of.

2.1.2 SAR ENERGY DATA (YEARLY DATA)

2.1.2.1 TIME HORIZONS

Total annual energies will be collected for Y-1. Data regarding year Y-1 are still provisional in most countries when collected in year Y. Indeed, the final official data are to be published many months later. For the same reason, data regarding year Y-2 sometimes differ from the data published in Y-1 because they have been updated in the meantime. Therefore, correspondents are invited to validate and update (if needed) the energy values for Y-2 when entering the values for Y-1.

2.1.2.2 NET GENERATION

Net Generation of a power station is the amount of energy it has produced in Y-1. ”Net” means the difference between, on the one hand, the gross generation of the alternator(s) and, on the other hand, the auxiliary equipments’ demand and the losses in the main transformers of the power station.

Power plants and projects should be assigned into predefined categories as they appear on the ENTSO-E-extranet (https://www.entsoe.eu/dataportal/entsoe.asp?smi=12_SAR_Energy Data (yearly data)).

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2.1.2.3 PHYSICAL IMPORTS AND EXPORTS

Physical imports and exports are metered at the exact border or at a virtual metering point estimated from the actual one(s).

2.1.2.4 PUMPED STORAGE CONSUMPTION

Pumped Storage Consumption is the energy used to pump water in the upper reservoirs.

2.1.3 SAR POWER DATA (MONTHLY DATA)

2.1.3.1 TIME OF REFERENCE

Times in the studies are expressed in Central European Time (CET=UTC[1]+1) in winter and in Central European Summer Time (CEST=UTC+2) in summer.

2.1.3.2 TIME HORIZONS

Data will be collected for Y-1.

2.1.3.3 REFERENCE POINTS

Reference points are the dates and times power data are collected for.

Data collected for the hour H are the average values from the hour H-1 to the hour H.

A single monthly reference point is defined in the retrospect reports:

- The 3rd Wednesday of each month on the 11th hour (from 10:00 CEST to 11:00 CEST in summer and 10:00 CET to 11:00 CET in winter)

2.1.3.4 NET GENERATING CAPACITY

Net Generating Capacity (NGC) of a power station is the nominal electrical net active power it can produce. ”Net” means the difference between, on the one hand, the gross generating capacity of the alternator(s) and, on the other hand, the auxiliary equipments’ load and the losses in the main transformers of the power station.

If the lowest voltage levels are not considered for load (see 2.1.3.9), which is net of generation on these voltage levels, then the generation connected to these lowest voltage levels should not be reported.

[1] UTC is the international designation for Universal Coordinated Time

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Power plants and projects should be assigned into predefined categories as they appear on the ENTSO-E-extranet (https://www.entsoe.eu/dataportal/entsoe.asp?smi=11 SAR Power Data (monthly data)).

2.1.3.5 NON-USABLE CAPACITY

Aggregates reductions of the net generating capacities due to the following causes:

- Temporary limitation due to constraints, like power stations in mothball or test operation, heat extraction for CHP's
- Limitation due to fuel constraints management
- Limitation reflecting the average availability of the primary energy source
- Power stations with output power limitation due to environmental and ambient constraints
- Etc.

2.1.3.6 MAINTENANCE AND OVERHAULS

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

2.1.3.7 OUTAGES

This category aggregates forced – i.e. not scheduled - unavailability of generating capacity.

2.1.3.8 SYSTEM SERVICES RESERVE

This capacity was required to maintain the security of supply according to the operating rules of each TSO.

2.1.3.9 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.

2.1.3.10 MARGIN AGAINST MONTHLY PEAK LOAD

To extend the results from a unique reference point to a whole month, ENTSO-E considers the Margin Against Monthly Peak Load.

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Margin Against Monthly Peak Load is the difference between load at the reference point and the peak load over the month.

Peak load is the maximum instantaneous value.

2.1.3.11 PHYSICAL IMPORTS AND EXPORTS

Physical imports and exports are metered at the exact border or at a virtual metering point estimated from the actual one(s).

2.1.4 SAR PEAK LOAD (YEARLY DATA)

Peak load is the maximum instantaneous value.

2.1.4.1 TIME OF REFERENCE

Times in the studies are expressed in Central European Time (CET=UTC[2]+1) in winter and in Central European Summer Time (CEST=UTC+2) in summer.

2.1.4.2 DATE

The day when your annual peak load occurred is selected.

2.1.4.3 DAILY AVERAGE TEMPERATURE

The daily average temperature of the selected date is collected.

2.1.4.4 DEVIATION FROM NORMAL AVERAGE TEMPERATURE

Correspondents enter the difference between the daily average temperature (2.1.4.3) and the typical average temperature for the calendar day of the selected date (2.1.4.2).

2.1.4.5 TIME

The time when your annual peak load occurred is selected.

2.1.4.6 PEAK LOAD

Peak load is the maximum instantaneous power value.

2.1.4.7 DIFFERENCE FROM LAST YEAR'S PEAK LOAD

The difference between the annual peak load of Y-1 and Y-2 is collected as a percentage of the latter one.

[2] UTC is the international designation for Universal Coordinated Time

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2.1.4.8 HISTORIC PEAK LOAD

The power value of the highest peak load ever is collected.

2.1.4.9 DATE OF HISTORIC PEAK LOAD

The day when your historic peak load occurred is selected.

2.1.4.10 DEVIATION FROM NORMAL AVERAGE TEMPERATURE

Correspondents enter the difference between the daily average temperature of the historic peak load and the typical average temperature for the calendar day of the selected date (2.1.4.9).

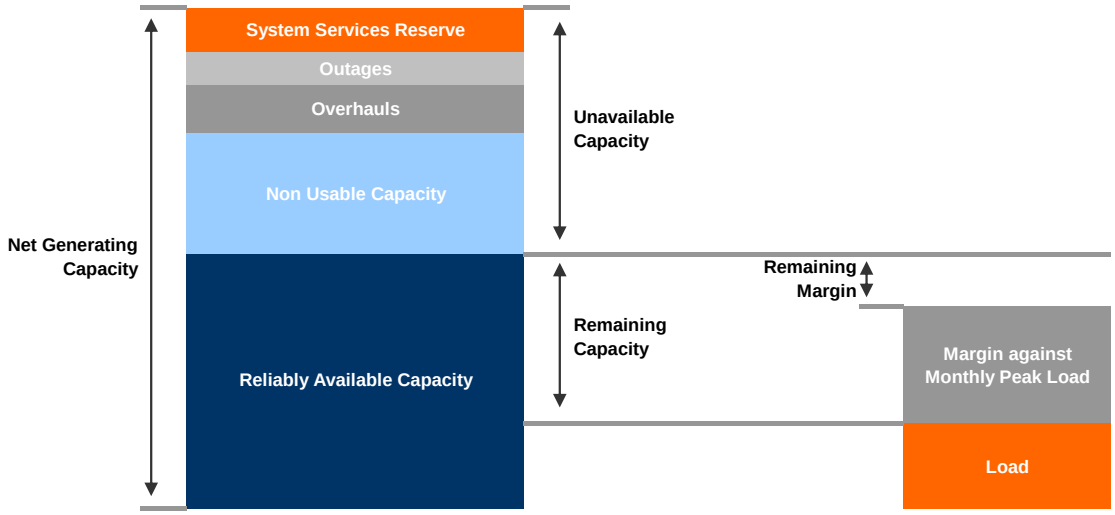
2.2 ADEQUACY RETROSPECT METHODOLOGY

2.2.1 POWER ASSESSMENT

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

- Reliably Available Capacity (RAC)
- Remaining Capacity (RC)
- Remaining Margin (RM)

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



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2.2.1.1 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 was not 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 actually available in the power system to cover the load at a respective Reference Point.

2.2.1.2 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

Remaining Capacity is the part of Net Generating Capacity left on the power system after Load at a Reference Point has been covered .

2.2.1.3 EXCHANGES

Exchanges are calculated as the difference between Physical Import and Physical Export of an individual country at the reference point.

Exchanges = Physical Imports – Physical Exports

2.2.1.4 REMAINING MARGIN

Remaining Margin on a power system is the difference between Remaining Capacity and Margin against Monthly Peak Load.

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Remaining Margin = Remaining Capacity – Margin against Monthly Peak Load

Remaining Margin is the part of Net Generating Capacity that has not been used to cover the Monthly Peak Load.

2.2.2 GENERATION ADEQUACY

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

Generation adequacy is assessed for each individual country, for each regional block identified within the ENTSO-E system and for the whole ENTSO-E.

2.2.2.1. GENERATION ADEQUACY RETROSPECT AT REFERENCE POINT

Generation adequacy retrospect on power system is assessed at the reference points through the Remaining Capacity value.

When Remaining Capacity is positive, it means that the power system had enough internal generating capacity left to cover its Load at reference point; when negative, it means that the power system had to cover its Load with the help of imports.

In case of negative remaining capacities in individual countries, the power balance is anyhow achieved when remaining capacity of the respective regional block or ENTSO-E is positive and interconnection capacities are sufficient to cope with the necessary exchanges.

2.2.2.2. MONTHLY PEAK LOAD GENERATION ADEQUACY RETROSPECT

The generation adequacy retrospect assessment is then monthly extended by using Remaining Margin (see chapter 2.2.1.4).

When Remaining Margin is positive, it means that the power system had enough internal generating capacity left to cover its load at any time of the month.

When Remaining Margin is negative, it means that the power system relied on imports to cover its monthly peak load.

The evolution of the annual minimum Remaining Margin throughout the years is a good indicator of the true evolution of the generation adequacy.

Remaining Margin is typically assessed on a country level. When summing Remaining Margins for different countries (regional blocks or ENTSO-E), a worst-case of peak load occurring at the same time in all countries is assessed.

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2.2.3 ENERGY ASSESSMENT

2.2.3.1 Consumption

Energy Consumption per country and per region is reported.

2.2.3.2 Generation

The Annual Total Generation and Generation Mix are reported per country, per regional block and ENTSO-E.

Generation Mix will consist of the predefined categories as they appear on the ENTSO-E-extranet (https://www.entsoe.eu/dataportal/entsoe.asp?smi=13 SAR Energy Data (yearly)).

2.2.3.3 Energy Flows

An Energy Flow assessment compares Physical Import and Export flows (see chapter 2.1.2.3), aggregated on a yearly basis. The assessment is being done both on a country and ENTSO-E-level.

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