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Council of European Energy Regulators

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Recommendations for the assessment of electricity generation adequacy

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Abstract

This document (C13-ESS-33-04) outlines CEER recommendations for the assessment of electricity generation adequacy in European countries.

In the wider context of energy security of supply, the European community has a growing interest in the ways in which generation adequacy is ensured in electricity markets; notably with increasing shares of variable generation (e.g. renewables).

In July 2013, the CEER the Electricity Security of Supply Task Force (ESS TF) undertook an investigation of the different ways assessments of generation adequacy are conducted. Subsequently, an overview of the findings in relation to the current approaches to national assessments was published in March 2014.

This present document provides recommendations for the further development of national generation adequacy assessments in order to achieve greater coordination and transparency across Europe, and is a first step towards establishing regional generation adequacy assessments.

Target Audience

European Commission, energy suppliers, traders, gas/electricity customers, gas/electricity industry, consumer representative groups, network operators, Member States, academics and other interested parties.

Keywords

Generation adequacy; security of supply; Energy policy, ENTSO-E System Outlook & Adequacy Forecast

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Related Documents

CEER documents:

CEER Assessment of electricity generation adequacy in European countries; March 2014

CEER Response to the European Commission Consultation Paper on generation adequacy, capacity mechanisms and the internal market in electricity; February 2013

CEER Call for Evidence on Generation Adequacy Treatment in Electricity (Evaluation of Responses); November 2011

ACER documents:

Energy Regulation: A Bridge to 2025 - Conclusions Paper; September 2014

ACER Opinion on the ENTSO-E summer outlook report 2014 and winter review 2013/14; July 2014

ACER Position on ENTSO-E Scenario Outlook and Adequacy Forecast 2013-2030; July 2013

ACER Opinion on the ENTSO-E winter outlook report 2012/13 and summer review 2012; March 2013

ACER Opinion on the ENTSO-E summer outlook report 2012 and winter review 2011/12; October 2012

ACER Opinion on the Ten-year network development plan 2012; September 2012

ACER Opinion on the ENTSO-E winter outlook report 2013/14 and summer review 2013; February 2014

ACER Opinion on the ENTSO-E summer outlook report 2013 and winter review 2012/13; November 2013

External documents:

ENTSO-E Scenario Outlook & Adequacy Forecast (SO&AF) 2013-2013; April 2013

ENTSO-E Scenario Outlook & Adequacy Forecast (SO&AF) 2014-2030; July 2014

ENTSO-E answer to the Agency's position on ENTSO-E Scenario Outlook and Adequacy Forecast 2013-2030; September 2013

ENTSO-E Ten-Year Network Development Plan 2014; July 2014 (draft version subject to consultation)

ENTSO-E Target Methodology for Adequacy Assessment - Consultation material; July 2014

European Commission Staff Working Document Generation Adequacy in the internal electricity market - guidance on public Interventions; November 2013

Related EU Directives and Regulations:

Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC

Regulation (EC) No 714/2009 of the European Parliament and of the Council of 13 July 2009 on conditions for access to the network for cross-border exchanges in electricity and repealing Regulation (EC) No 1228/2003

Directive 2005/89/EC of the European Parliament and of the Council of 18 January 2006 concerning measures to safeguard security of electricity supply and infrastructure investment (Text with EEA relevance)

Table of Contents

Executive Summary

With the objective of delivering sustainable and secure energy, and a competitive internal energy market (IEM), it is clear that security of supply is no longer exclusively a national consideration, but increasingly a regional and pan-European issue. While the need for a coordinated approach in the design and implementation of policy instruments that are considered to ensure generation adequacy is being discussed at the European level, different countries continue to use very heterogeneous approaches to undertake generation adequacy assessments.

In 2013, CEER analysed current practices and different methods used to assess generation adequacy across Europe in our report on “Assessment of generation adequacy in European countries” (published in 2014). CEER’s view is that these different procedures pose difficulties (especially for neighbouring countries) as it is a challenge to understand the different procedures and processes from one country to another.

In this present report, CEER focuses on the need for an in-depth analysis and further work on the establishment of best practises and common methodologies; recommendations for the most promising possibilities for further development of national generation adequacy assessments are outlined, in order to achieve greater coordination and transparency of national reports. These recommendations below) are based on the findings of CEER’s previous report and are considered a necessary first step towards regional generation adequacy assessments instead of purely national ones:

1. Explicitly specify roles and responsibilities in order to ease stakeholders’ understanding of the reports.

2. Enhance international comparability by making explicit reference and explaining the differences between the national analysis and the ENTSO-E methodology.

3. Explain the adequacy methodology and standards employed in the adequacy reports.

4. Enhance data quality and reliability by explicitly comparing ex-ante assumptions with ex-post realisation and delivering long and reliable data time-series to be used for benchmarking historical data.

5. Improve assumptions on programmable capacity availability and reliability by comparing evaluations based on direct information and historical data with analysis of theoretical models and simulations.

6. Clarify availability levels for intermittent generation used in the national reports and make reference to best practices on how to model non-programmable generation.

7. Make an explicit consideration of flexibility in the generation adequacy assessment and disaggregate needs for each resource.

8. Take into account the potential benefit provided by interconnectors in the national generation adequacy analyses in a coordinated and consistent way across MS. In the long run, adopt a pan-European (ENTSO-E) approach to the treatment of cross-border interconnection capacity.

1. Introduction

Until now[1], generation adequacy assessments have largely been considered a national issue. However, more recently, a shift in focus towards a European approach can be observed in European energy policy debate and is reinforced by several recent developments:

- The aim of the on-going energy market integration process in Europe is to ensure an efficient cross-border use of existing generation, demand-side and storage resources, as well as transmission infrastructure and to facilitate efficient system expansion.
- In addition, the use of existing and future infrastructure should be maximised to ensure security of supply for all European customers in an efficient and economic way.

This notion is already taken forward through grid planning in the Ten-Year Network Development Plan (TYNDP) published by the European Network of Transmission System Operators for electricity (ENTSO-E) every two years[2].Further to this, ENTSO-E is also working on substantial improvements to the methodologies used in the assumptions for generation adequacy assessments[3] which deliver relevant input data for an efficient grid planning based on realistic assumptions.

With the objective of delivering sustainable and secure energy, and a competitive internal energy market (IEM), it is clear that security of supply is no longer exclusively a national consideration, but increasingly a regional and pan-European issue. Consequently, generation adequacy should be addressed and coordinated at the regional and European levels in order to maximise the benefit of the IEM.

While the need for a coordinated approach in the design and implementation of policy instruments that are considered to ensure generation adequacy is being discussed at the European level, different countries continue to use very heterogeneous approaches to undertake generation adequacy assessments. This raises the question as to whether a comprehensive analysis of European-wide generation adequacy can be carried out without a harmonised approach on the assessment and calculation of generation adequacy at national level.

It is also important that national generation adequacy analyses take into account the potential benefit provided by interconnectors and fully reflect contributions by parties on the demand side of the market. That is also valid when considering the implementation of any action/mechanism to ensure generation adequacy.

[1] For example in the CEER Call for Evidence (2011) and CEERs Response to EC Public Consultation (2013)

[2] ENTSO-E Ten-Year Network Development Plan 2014: https://www.entsoe.eu/major-projects/ten-year-network-development-plan/tyndp-2014/Pages/default.aspx

[3] ENTSO-E Scenario Outlook and Adequacy Forecast (SO&AF) 2014-2030: https://www.entsoe.eu/Documents/TYNDP%20documents/TYNDP%202014/140602_SOAF%202014-2030.pdf

In 2013, CEER analysed current practices and methods used to assess generation adequacy across Europe. The CEER report on "Assessment of generation adequacy in European countries"[4] (published in 2014) builds on the results of an internal questionnaire and provides an overview of the findings.

It became clear through this exercise that national generation adequacy assessments are undertaken in quite different ways across Europe. CEER's view is that these different procedures pose difficulties (especially for neighbouring countries) as it is a challenge to understand the different procedures and processes from one country to another, e.g. concerning the consideration of interconnectors in generation adequacy assessments.

Further to the difference in approach, there are also differences between the System Outlook & Adequacy Forecast (SO&AF)[5] undertaken by ENTSO-E and the national assessments that occurs due to different quality of data and a more sophisticated approach in some countries, in order to prove the resilience of one or the other by considering top-down as well as bottom-up information.

In this present report, CEER focuses on the need for an in-depth analysis and further work on the establishment of best practises and common methodologies; recommendations for the most promising possibilities for further development of national generation adequacy assessments are outlined, in order to achieve greater coordination and transparency of national reports. These recommendations are based on the findings of CEER's previous report (noted above) and are considered a necessary first step towards regional generation adequacy assessments instead of purely national ones.

This paper does not address the need to move beyond assessments of generation adequacy to broader assessments of the balance between supply and demand – which we term elsewhere "system adequacy". This is not to downplay the importance of system adequacy – and in particular factoring in demand side flexibility, which we set out in the ACER Bridge to 2025 paper[6]. It is rather to focus first on the shorter-term improvements in current methodologies which build on our work in previous documents and which are important both for generation adequacy and for system adequacy.

The recommendations are listed in brief here below, and fully detailed in Chapter 2 of this paper:

1. Explicitly specify roles and responsibilities in order to ease stakeholders' understanding of the reports.

2. Enhance international comparability by making explicit reference and explaining the differences between the national analysis and the ENTSO-E methodology.

3. Explain the adequacy methodology and standards employed in the adequacy reports.

[4] CEER Report on generation adequacy assessments (2014)

[5] https://www.entsoe.eu/fileadmin/user_upload/_library/publications/entsoe/So_AF_2013-2030/130403_SOAF_2013-2030_final.pdf

[6] Energy Regulation: A Bridge to 2025 - Conclusions Paper

4. Enhance data quality and reliability by explicitly comparing ex-ante assumptions with ex-post realisation and delivering long and reliable data time-series to be used for benchmarking historical data.

5. Improve assumptions on programmable capacity availability and reliability by comparing evaluations based on direct information and historical data with analysis of theoretical models and simulations.

6. Clarify availability levels for intermittent generation used in the national reports and make reference to best practices on how to model non-programmable generation.

7. Make an explicit consideration of flexibility in the generation adequacy assessment and disaggregate needs for each resource.

8. Take into account the potential benefit provided by interconnectors in the national generation adequacy analyses in a coordinated and consistent way across MS. In the long run, adopt a pan-European (ENTSO-E) approach to the treatment of cross-border interconnection capacity.

2. Consumer perspective

The assessment of generation adequacy is important for energy customers because it seeks to ensure that their electricity supply will remain secure and constant. A robust and coherent methodology for calculating adequacy is important to facilitate sufficient future planning to deliver our energy supply. Understanding how our neighbouring countries manage this process can provide useful lessons.

3. Recommendations

Assessing generation adequacy is a complex activity that requires a variety of tasks, such as defining key concepts (generation adequacy[7], adequacy criteria, system stress, etc.) and setting out the procedures to be adopted for monitoring generation adequacy.

Although national generation adequacy reports require further development in order to meet the additional present and future needs (e.g. to address intermittent energy sources), the establishment of the IEM means the scope of national assessments will also need to broaden. CEER believes that the following recommendations should facilitate this process.

3.1. Explicitly specify roles and responsibilities in order to ease stakeholders' understanding of the reports

The responsibility of ensuring generation adequacy rarely varies between countries; it is clearly defined across Europe and in almost all countries, it is a responsibility attributed to the respective national governments. However, in contrast to short-term system operation, there is no homogenous approach to ensuring generation adequacy in the long term, which is a responsibility of each Member State (MS). In order to enhance clarity and facilitate stakeholder understanding of national generation adequacy reports, it is advisable that the **roles and responsibilities with respect to generation adequacy are clearly stated in the reports** (e.g. at the beginning or in an ad hoc appendix).

3.2. Enhance international comparability by making explicit reference and explaining the differences between the national analysis and the ENTSO-E methodology

For the purposes of comparability, it is advisable that MSs **refer to the ENTSO-E methodology on the time span of scenarios** (found in the Scenario Outlook[8]) in their national scenarios, in order to evaluate generation adequacy. Furthermore, MS are encouraged to **explain the differences in assumptions and scenarios** between the national analysis and the ENTSO-E analysis[9].

[7] The European Commission Electricity Coordination Group, in the sub-group on generation adequacy indicates in its report (November 2013) that "Generation Adequacy is a basic mechanism to measure whether there will be sufficient sources of electricity in a system to meet the expected requirements".

[8] See footnote 3.

[9] See ENTSO-E, Target Methodology for Adequacy Assessment - Consultation material

3.3. Explain the adequacy methodology and standards employed in the adequacy reports

A wide variety of reliability standards exist within European countries; in the nine countries which apply reliability standards, the underlying methodologies to define them also differ. Most such standards are based on a probabilistic assessment (LOLE/LOLP/EUE),[10] while a few take into account a deterministic assessment (capacity margins). It is widely agreed that National decision makers should retain the right to set their adequacy methodologies and standards; this includes setting the appropriate indicator(s) and thresholds to measure security of supply. However, a common set or menu of indicators could be devised and applied across all MS. It is necessary that these criteria are defined locally in order to take into account local circumstances and national specificities, expectations and the unique characteristics of the electric system in question.

It is advisable that when the approach is determined by MS, it should strictly be the result of **a clear and common predefined methodology**.

3.4. Enhance data quality and reliability by explicitly comparing ex-ante assumptions with ex-post realisation and delivering long and reliable data time-series to be used for benchmarking historical data

The quality of data adopted for generation adequacy assessments is one of the most important issues, for national and European generation adequacy assessments. Considerable effort should be devoted to enhancing data quality and to ensuring the compatibility of assumptions throughout MS.

MSs should also consider what the best available data sources for their assessment are and undertake a systematic data quality check. It is advisable that (whenever they arise) possible **discrepancies between assumptions and realisation are explicitly taken into account and noted in the reports**.

Data quality can also benefit from producing and delivering long and reliable data time-series to be used for benchmarking historical data. It is advisable that any **systematic deviation (e.g. overestimations or underestimations of data) that might emerge is explicitly addressed in the reports**. This quality check, which might require time to be implemented, can result in proposals for improvements in terms of data used.

[10] See Annex 2, List of abbreviations for explanations.

3.5. Improve assumptions on programmable capacity availability and reliability by comparing evaluations based on direct information and historical data with analysis of theoretical models and simulations

In the assessment reports, whenever uncertainties on generation output from programmable capacity are explicitly taken into account, probabilistic and/or deterministic approaches (e.g. based on expected or average outages) are used. In some cases, experience from previous years' respective assessments from historical data may provide a valuable indication of the behaviour of generation profiles. Direct information from generators (and market participants in general) may by itself not always prove sufficiently precise and robust enough to elaborate valuable assumptions on availability and reliability of different resources.

It is advisable that (whenever possible) **the evaluation based on direct information is compared with analysis of theoretical models and simulations**. In this case, the methodology employed to provide such an analysis should be explicated and comparison between reported real data and theoretical one undertaken and commented.

3.6. Clarify availability levels for intermittent generation used in national reports and make reference to best practices on how to model non-programmable generation.

There are several ways in which generation from non-programmable output is considered in generation adequacy assessment reports; from no consideration at all, to a precise estimation of variable generation output per modelling time unit based on sophisticated data. It is commonly agreed that there is a need to improve methodologies to better address how variable output impacts adequacy.

It is strongly advised to make reference to best practices on how to model non-programmable generation within generation adequacy assessments, as we move towards a future with increasing intermittency. As a first step, the availability levels for intermittent generation used in national reports and how these levels are determined should be clarified.

The desired long-term direction should be to align the different national methodologies, in respect to non-programmable generation output modeling, with the future ENTSO-E SO&AF methodology which is (proposed to be) based on a probabilistic approach over a long time series of historical weather data.

3.7. Make an explicit consideration of flexibility in the generation adequacy assessment and disaggregate needs for each resource

Current generation adequacy assessments concentrate on the potential capacity that would be needed in different time horizons, but do not take into consideration flexibility and balancing mechanism issues in order to ensure operational reliability. Increasing renewable energy source (RES) penetration makes flexibility more important for ensuring operation reliability, which is generally addressed in short-term system operation.

But, explicit consideration of flexibility in generation adequacy assessments is necessary, considering the envisaged high penetration of RES (especially wind resources). Therefore, **it is advisable that the level of capacity needed is disaggregated for each resource that would be required to cover the demand in the given period to highlight the potential future need for flexibility**.

3.8. Take into account the potential benefit provided by interconnectors in national generation adequacy analyses in a coordinated and consistent way across MSs.

Interconnectors can bring significant benefits to the security of energy supply and decrease overall costs for MS. However, not all national generation adequacy outlooks consider the potential of importing electricity for securing supply in their electricity systems.

Therefore, **it is important that national generation adequacy analyses take into account the potential benefit provided by interconnectors.**

Where interconnections are considered, there is no common modelling methodology. The availability of interconnection capacity is mostly based on historical data (export and import flows during various periods of time), while estimated data is rarely considered in the analyses (e.g. market component such as future prices estimations). Furthermore, cross-border coordination in modelling assumptions and data ensuring consistency between the different methodologies used are also rarely considered; this should be improved.

In the longer term, **the end goal should be to establish a pan-European SO&AF approach to how interconnectors are considered for the assessment of national generation adequacy. As an intermediate step, MS should be encouraged to consult and coordinate the approach with their direct neighbours and/or at regional level** so that a consistent and compatible approach is taken on both sides of the border in order to achieve valuable generation adequacy outlooks and efficient market based mechanisms.

4. Conclusions

In this present report, CEER focuses on the need for an in-depth analysis and further work on the establishment of best practises and common methodologies for the assessment of generation adequacy in European countries.

CEER presents recommendations based on our previous findings[11] and are considered a necessary first step towards regional generation adequacy assessments instead of purely national ones.

This paper does not address the need to move beyond assessments of generation adequacy to broader assessments of the balance between supply and demand – which we term elsewhere "system adequacy" – but rather focuses first on the shorter-term improvements in current methodologies which build on our work in previous documents and which are important both for generation adequacy and for system adequacy.

Europe's energy regulators set out their commitments (short and long term) towards improving the approach for ensuring overall system adequacy (and in particular factoring in demand side flexibility) in the ACER Bridge to 2025 paper[12], and welcome the opportunity to continue working closely with all involved actors.

[11] CEER Report on generation adequacy assessments (2014)

[12] Energy Regulation: A Bridge to 2025 - Conclusions Paper

Annex 1 – CEER

The Council of European Energy Regulators (CEER) is the voice of Europe's national regulators of electricity and gas at EU and international level. Through CEER, a not-for-profit association, the national regulators cooperate and exchange best practice within and beyond Europe's borders. CEER includes national regulatory authorities from 33 European countries (the EU-28, Iceland, Norway, Switzerland, FYROM, Montenegro and growing).

One of CEER's key objectives is to facilitate the creation of a single, competitive, efficient and sustainable EU internal energy market that works in the public interest. More specifically, CEER is committed to placing consumers at the core of EU energy policy. CEER believes that a competitive and secure EU single energy market is not a goal in itself, but should deliver benefits for energy consumers.

CEER works closely with (and supports) the Agency for the Cooperation of Energy Regulators (ACER). ACER, which has its seat in Ljubljana, is an EU Agency with its own staff and resources. CEER, based in Brussels, deals with many complementary (and not overlapping) issues to ACER's work such as international issues, smart grids, sustainability and customer issues. European energy regulators are committed to a complementary approach to energy regulation in Europe, with the Agency primarily focusing on its statutory tasks related to EU cross-border market development and oversight, with CEER pursuing several broader issues, including international and customer policies.

The work of CEER is structured according to a number of working groups and task forces, composed of staff members of the national energy regulatory authorities, and supported by the CEER Secretariat.

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Annex 2 – List of abbreviations

Term	Definition
ACER	Agency for the Cooperation of Energy Regulators
CEER	Council of European Energy Regulators
ENTSO-E	European Network Transmission System Operators for Electricity
EUE	Expected Unserved Energy
IEM	Internal Energy Market
LOLE	Loss of load expectation
LOLP	Loss Of Load Probability
MS	Member State
RES	Renewable energy sources
SO&AF	System Outlook and Adequacy Forecast
TSO	Transmission system operator