ACER

European Union Agency for the Cooperation of Energy Regulators

ACER webinar: implementation of the EU methodology for electricity adequacy metrics

5 June 2024

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European Union Agency for the Cooperation of Energy Regulators

Agenda

Indicative time	Webinar items	
09:45 - 10:00	Webinar open for log-in	Starts promptly at 10:00
10:00 - 10:05	**Introductory Remarks** Vasilis PAPANDREOU, ACER	
10:05 - 10:50	Results of the study on adequacy metrics Johannes REICHL, Johannes Kepler Universität Linz Aaron PRAKTIKNJO, RWTH Aachen University	
10:50 - 11:25	Q&A	
11:25 - 11:30	**Closing Remarks** Vasilis PAPANDREOU, ACER	

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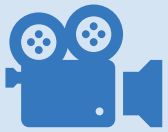

This meeting will be recorded

Questions from other participants can be 'liked' to increase their visibility

Slides and recording of this webinar will be uploaded to ACER website

Microphones will be muted throughout the webinar

Substance-related questions will be addressed during the relevant Q&A session; although they can be posed at any point

ENERGIEINSTITUT an der Johannes Kepler Universität Linz

JOHANNES KEPLER UNIVERSITÄT LINZ

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RWTH Aachen University

05.06.2024

Public Webinar

Purpose of today's webinar

1) Present final results of the VOLL/CONE/RS Study:
   "Review of Member States' Practices regarding the Implementation of the Methodology for calculating the Value of Lost Load, the Cost of New Entry and Reliability Standard for the European Union Agency for the Cooperation of Energy Regulators"

2) Interaction with interested parties via:
   - Q&A and slido polls

Agenda for today's public webinar

- Introduction
  - Team
  - Introduction to the Topic and why a Study was Launched
  - Overview of Study and Structure of Methods Applied in the Study
- Overview of Main Results
  - **Focus: Value of Lost Load**
    - Analysis
    - Recommendations for Facilitating Future Calculations
  - Cost of New Entry and Reliability Standard
    - Overview and Main Conclusions
- Possibility for Q&A (Questions via Slido)

Slido

(please answer only one of the two questions, see instructions)

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Introduction

Who we are…

- Non-university research institute, founded in 2001
- Legal form: non-profit organisation
- As of 09/2023:
  - 40 employees
  - 100 R&D projects p.a.
  - Currently 85 ongoing projects (15 HORIZON-EU projects)
- Departments: Energy Economics, Energy Law, Energy Technology
- There we conduct research in the following areas, among others:
  - Energy infrastructure
  - Energy behavior, commitment & acceptance
  - Market design & regulation
  - Industrial processes & circular economy
  - Hydrogen & CCUS & Power-to-X
  - Energy communities & demand flexibility

UNIV.-PROF. DR. JOHANNES REICHL
Scientific Director, Dpt. of Energy Economics

RUDOLF KAPELLER MSC
Junior Researcher

KATHARINA RUSCH MSC
Junior Researcher

MELANIE KNÖBL MA
Junior Researcher

Who we are…

- Chair for Energy System Economics, RWTH Aachen University founded 2021
- As of 12/2023:
  - 10 researchers, 14 research assistants
  - Various research projects on the analysis of energy system from the perspective of economics, policy and technology
- Selected projects and publications of our research:
  - Artificial intelligence to investigate the security of electricity supply (KIVi), funded by Federal Ministry of Economics and Climate Protection (BMWK), (2020-2023)
  - Medium-term forecast for the nationwide supply of electricity to end consumers for the calendar years 2023 to 2027, (2022)
  - Nolting, L., Praktiknjo, A. (2022). The Complexity Dilemma – Insights from Security of Electricity Supply Assessments. Energy, 122522. [ScienceDirect]
  - Priesmann, J., […] Praktiknjo, A. (2022). Does Renewable Electricity Hurt the Poor? Exploring Levy Programs to Reduce Income Inequality and Energy Poverty Across German Households, Energy Research and Social Sciences, 93, 102812.
  - Kockel, C., Nolting, L., Priesmann, J., Praktiknjo, A. (2022). Does Renewable Electricity Supply Match with Energy Demand? – A Spatio-Temporal Analysis for the German Case, Applied Energy, 308, 118226. [ScienceDirect]

UNIV.-PROF. DR.-ING. AARON PRAKTIKNJO
Institute Co-Director, Head of the Department

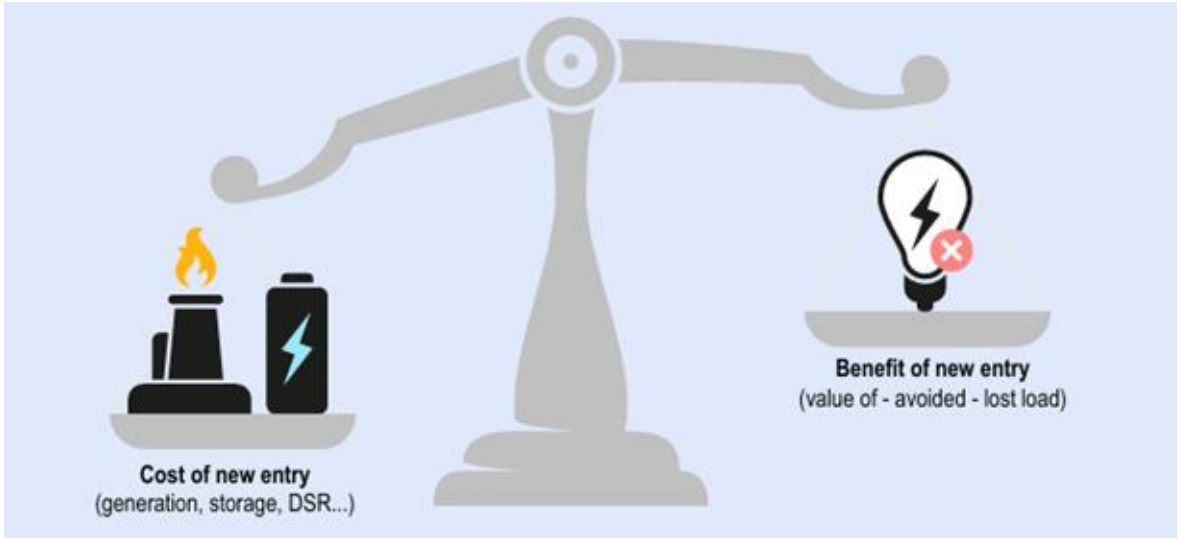
CHRISTINA KOCKEL MSC
Chief Engineer

JAN PRIESMANN MSC
Research Associate

JAKOB KULAWIK MSC
Research Associate

Introduction: Security of Supply

- **Security of supply** means the ability of an electricity system to guarantee the supply of electricity to customers with a clearly established level of performance, as determined by the Member States concerned
- A **reliability standard** shall indicate the necessary level of security of supply of the Member State
- When applying **capacity mechanisms** Member States shall have a reliability standard in place



Source: ACER

A socioeconomically efficient reliability standard (RS) strikes a balance between the cost of having additional capacity (CONE) and the benefits of having less demand disconnections (VOLL)

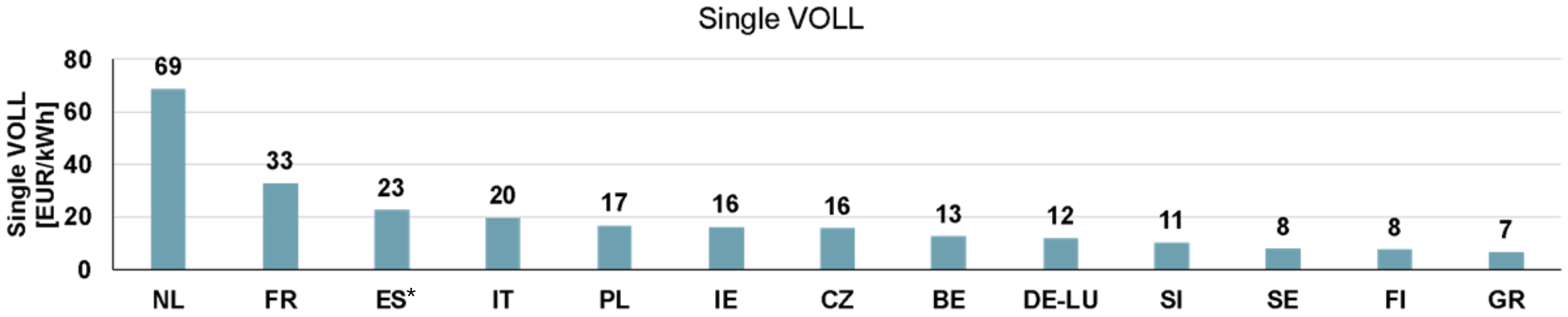
Introduction: VOLL, CONE and RS

- The calculation of the RS, the VOLL and the CONE shall be based on the **EU-wide Methodology**[1] for calculating the value of lost load, the cost of new entry and the reliability standard (Methodology) approved by the Agency in October 2020 (Decision No 23/2020)
- **VOLL** (Value of Lost Load) is a measure used for quantifying the **damage caused by interruptions of the electricity supply** and expressed in EUR/kWh
- **CONE** is a measure in Euro/MW and means both fixed and variable **cost of new entry for different reference technologies** (RT), and is based on techno-economic information
- **RS** is expressed as the **expected number of hours** (LOLE) during which **capacity resources are insufficient** to meet the demand and is based on VOLL and CONE

[1]ACER Decision on the Methodology for calculating the value of lost load, the cost of new entry, and the reliability standard: Annex I – Methodology for calculating the value of lost load, the cost of new entry and the reliability standard in accordance with Article 23(6) of Regulation (EU) 2019/943 of the European Parliament and of the Council of 5 June2019 on the internal market for electricity, 2 October 2020, https://www.acer.europa.eu/sites/default/files/documents/Individual%20Decisions_annex/ACER%20Decision%2023-2020%20on%20VOLL%20CONE%20RS%20-%20Annex%20I_1.pdf

Why a study was launched

- Following the approval of the Methodology on 2 October 2020 Member States have been gradually implementing it to calculate the adequacy metrics
- ACER found significant differences between the results, especially regarding VOLL values and divergent approaches in the calculations processes across Member States
- This suggests that the differences in approaches potentially influence the final results (see detailed study results from sl. 16 onward)
- ACER is interested in understanding whether the differences in the calculation results relate to the level of implementation of the methodology, and how it was implemented, as well as in identifying implementation challenges and good practices

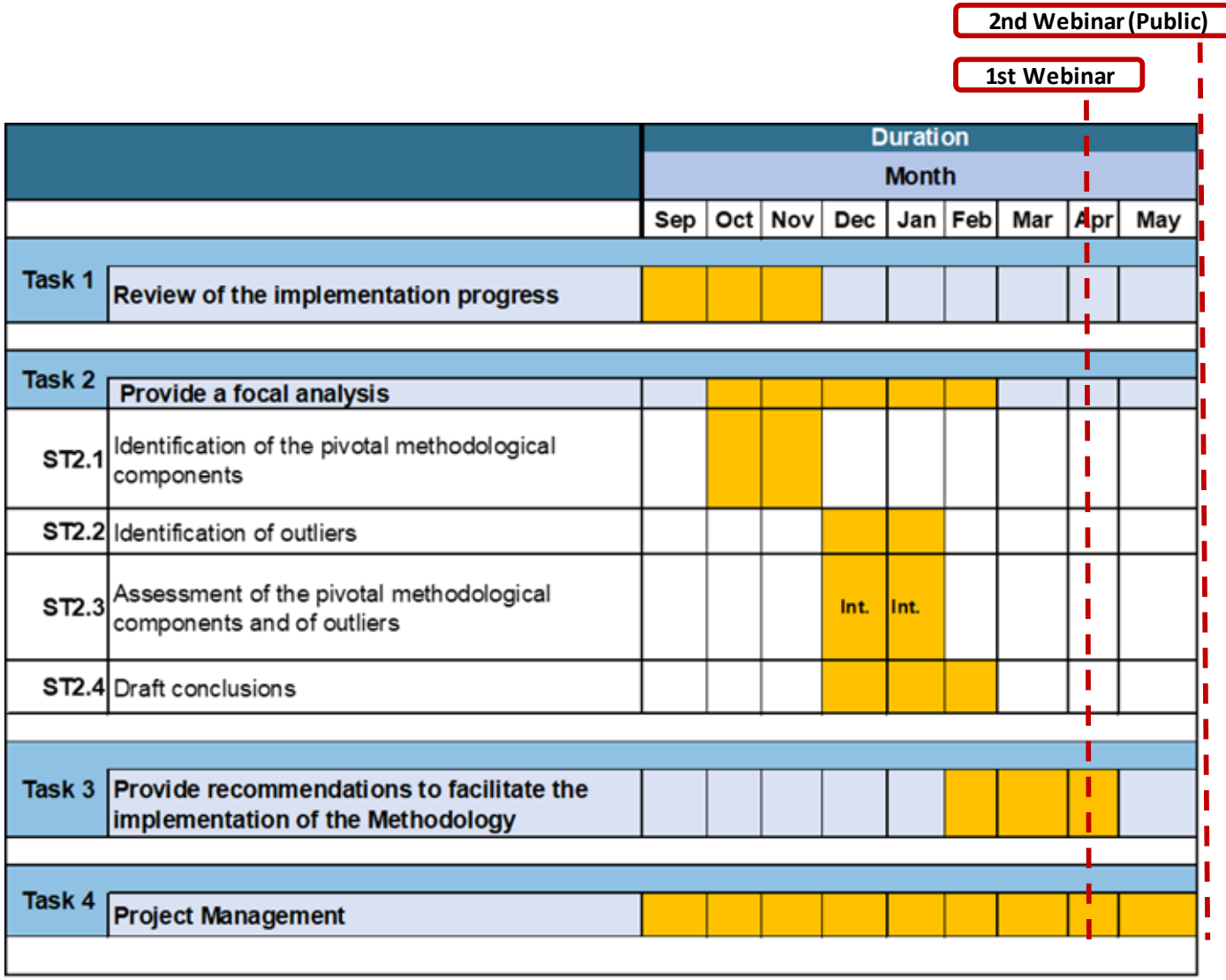


*The values for Spain have not yet been approved.

Overview of the study

- The aim is to identify challenges encountered during the calculation processes
- …and propose strategies for enhancing future implementations of the Methodology
- Basis for the analysis are the VOLL, CONE and RS reports of Member States and interviews with the relevant entities

- Task 1 produced an overview of the implementation status of each Member State
- Task 2 identified the most significant aspects of the methodology, and assessed methodological approaches, challenges and outliers in the results
- Task 3 offers recommendations for improving future applications of the Methodology



Structure of methods and scope

- The study includes Member States that
  - have a capacity mechanism in place, or
  - have calculated at least one of the reliability metrics after the publication of the methodology
- Desk research to analyze VOLL/CONE/RS reports of Member States
  - Identify most significant aspects of the Methodology
  - Assess the implementation approaches of the countries
  - Identify deviations and possible outliers
- Structured interviews with the entities tasked to calculate the metrics
  - Evaluate the overall implementation process
  - Identify implementation challenges
- Stakeholder feedback and presentation of results in two webinars

Year of report

Country	VOLL	CONE	RS	Interview
Belgium	2022	2022	2022	YES
Czech Republic	2023	2023	2023	YES
Finland	2021	2021	2022	YES
France	2022	2022	2022	YES
Germany/Luxembourg	2021	2021	2021	YES
Greece	2021	2021	2021	YES
Ireland	2023	2023	2023	YES
Italy	2021	2021	2021	YES
Sweden	2021	2021	2021	YES
Slovenia	2022	2022	2022	YES
Spain	2023	2023	2023	YES
Poland	2023	2023	x	YES
Netherlands	2022	x	x	YES

Value of Lost Load

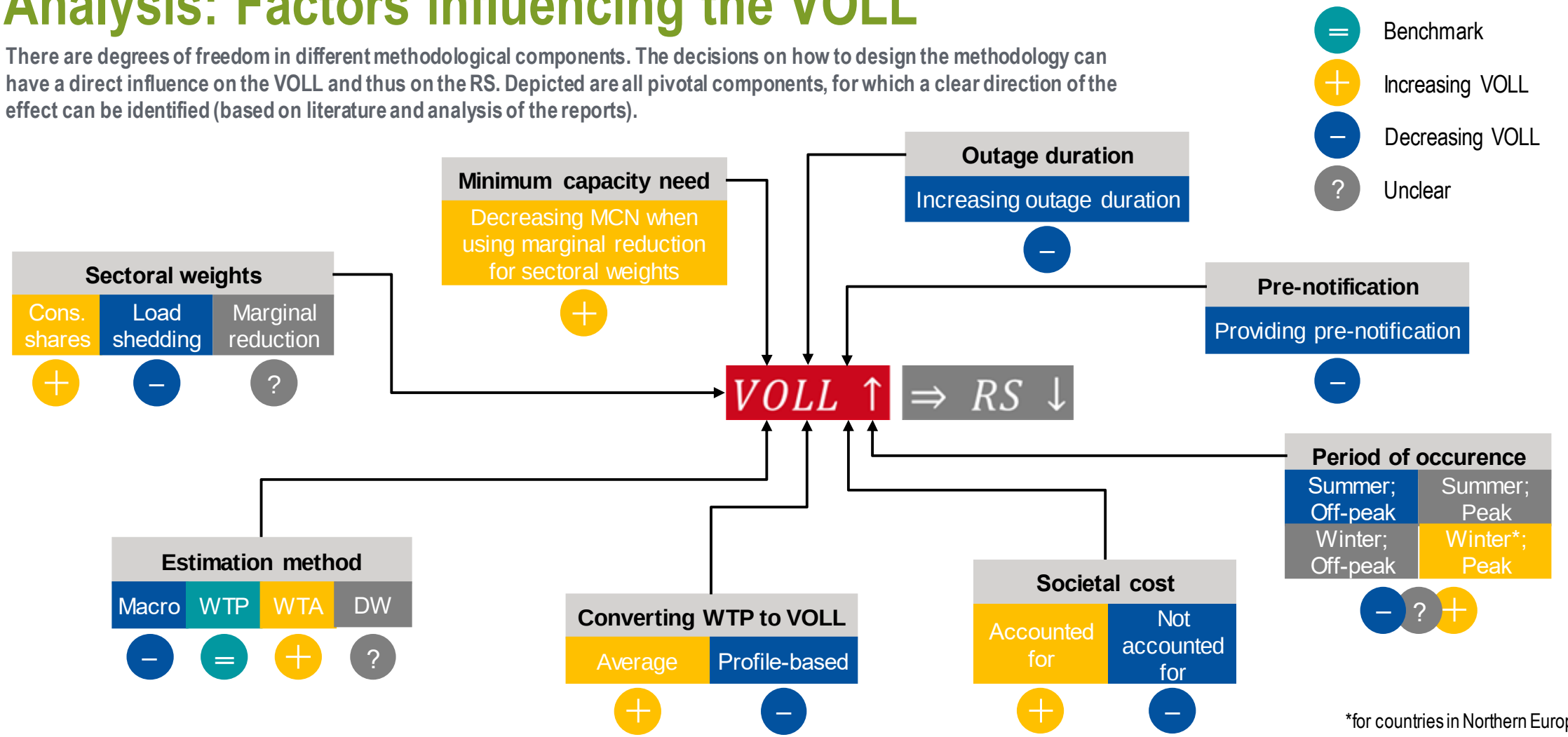
Survey based procedure for determining the VOLL

- Various methods exist for determining the VOLL (e.g. survey, macro data, revealed preferences); the ACER methodology calls for a **survey-based approach**
- Conducting a **new survey** for the different consumer categories using a **standardized questionnaire** or alternative use of **existing surveys** from the last 5 years, which fulfill the requirements set by the ACER methodology
- Three most common survey-based methods for estimating the VOLL are willingness-to-pay (**WTP**), willingness-to-accept (**WTA**) and **direct worth**
- In the ACER methodology **WTP is defined as the baseline**, however other methods can also be used to calculate the VOLL → **choice of estimation method has strong impact** on the resulting VOLL

Minimum survey components:
- Information about the type of consumer
- Information about the electricity consumption
- Power interruption scenarios for evaluation, have to be specified regarding
  - ➢ Outage duration
  - ➢ Period of occurrence
  - ➢ Pre-notification

Analysis: Factors influencing the VOLL

There are degrees of freedom in different methodological components. The decisions on how to design the methodology can have a direct influence on the VOLL and thus on the RS. Depicted are all pivotal components, for which a clear direction of the effect can be identified (based on literature and analysis of the reports).



*for countries in Northern Europe

Variety of methodological decisions

Degrees of freedom within the methodology as well as lack of adequately implementing the methodology can lead to a large variation in resulting single VOLLs.

Estimation method (example for degrees of freedom):

Estimating the Willingness to Pay (WTP) is the preferred approach for calculating the VOLL. However, other approaches, namely Willingness to Accept (WTA) and Direct Worth can also be applied. Practical experience shows that a VOLL estimate based on WTA is systematically higher than based on WTP.

Which approaches were used to calculate the single VOLL?

Only WTP: **3**	Share of WTA: **6**	Other approaches: **4**

Weighting of sectoral VOLLs (example for lack of implementation):

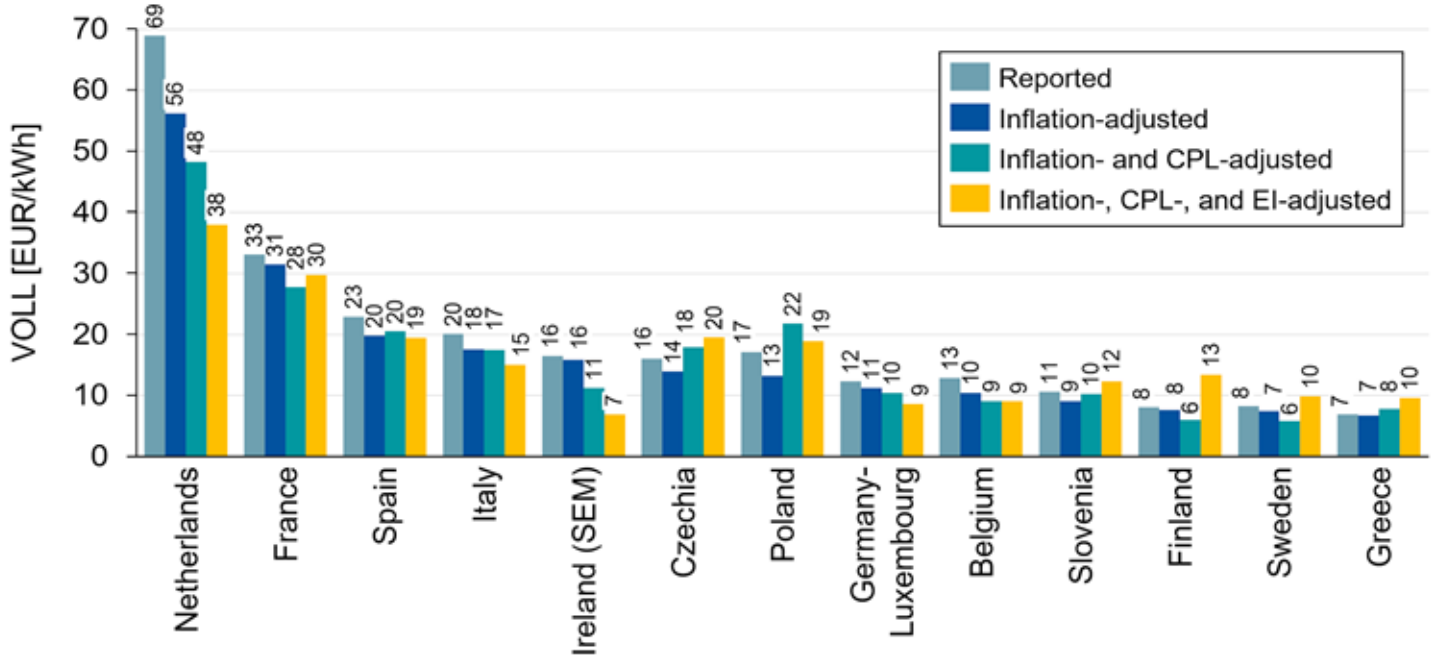
According to the ACER methodology, the estimated sectoral weights can be weighted and then combined to a single VOLL either using (1) average share of load shedding in case of an outage or (2) average marginal reduction of load shedding due to additional capacities. Using average consumptions shares instead can result in a significantly higher single VOLL.

Which approaches were used for weighting sectoral VOLLs?

Average load shedding: **7**	Average marginal reduction: **0**	Average consumption shares: **6**

Analysis: Comparison of VOLLs across member states

For the sake of comparison, the reported VOLLs are adjusted to the calculation year by accounting for inflation (2015 = 100) and then adjusted to differences between member states by using (1) comparative price levels (CPL) (EU27 average = 100) and (2) the electricity intensity[1] (EI) as the ratio between the GDP and the total electricity consumption (EU27 average = 100).



- After applying all adjustment measures, the **Netherlands** have the highest single VOLL
- The **order of VOLL between member states** changes based on the adjustment method as the adjustment can **result in both, higher and lower adjusted VOLLs** compared to the originally reported values
- The **adjustment for inflation, CPL and EI** reduces the large spread of VOLLs across member states

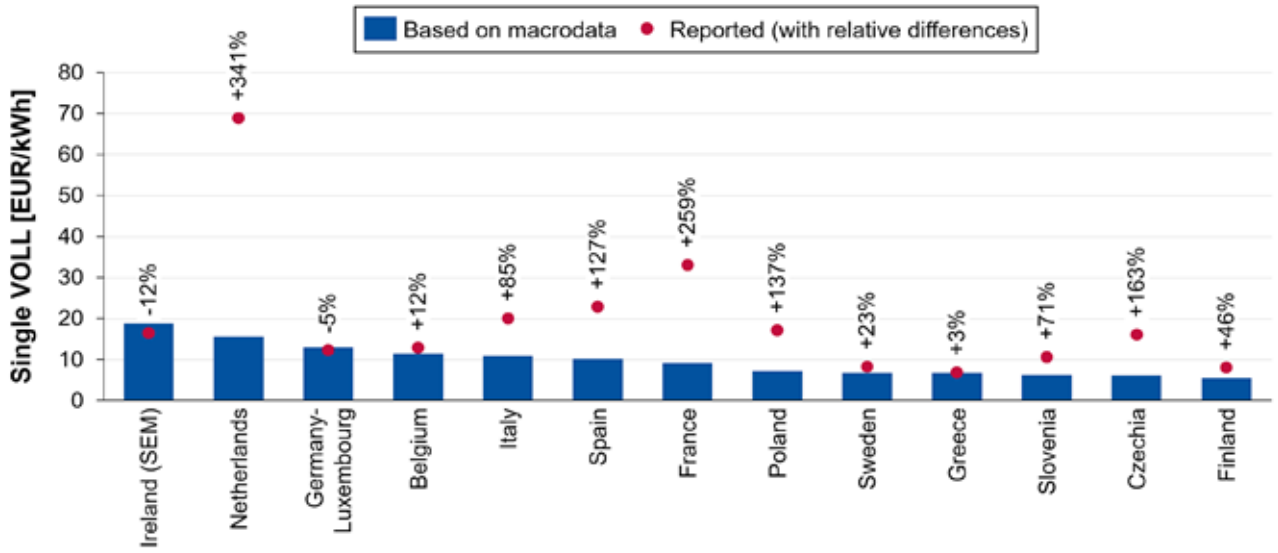
➢ After adjusting the reported VOLLs, the difference between the **maximum and minimum VOLL** across all MS reduces from **62 to 35 EUR/kWh**

~40% of the differences (variance) in the VOLL across member states can be explained with **differences in inflation rates**, **comparative price levels** and **electricity intensity** at time of conducting the survey[2]. As there are still major differences even after these adjustments that cannot be explained intuitively, a thorough analysis was conducted.

[1] GDP per kWh of electricity consumption; [2]based on the adjusted R^2 of a linear regression

Analysis: Comparison of VOLLs to a macrodata-based benchmark

The macrodata-based VOLL has been calculated using a simplified procedure and based on data from Eurostat and OECD.



*The macrodata-based VOLL should only be considered as a general benchmark to assess the reported survey-based VOLL values. Due to the simplified approach, these values should not be used directly for further analysis of the security of supply standard.

- It can be expected that the **macrodata-based VOLLs** are **lower** than the respective VOLLs based on WTP or WTA as they **only include risk-neutral cost components** and do **not incorporate non-measurable costs** (e.g.data losses)
- Only **Germany-Luxembourg** reported a macrodata-based VOLL (relative difference stems from different underlying data)
- As expected, the **majority of reported VOLLs** are higher than the macrodata-based VOLLs

➢ The reported VOLL values of the **Netherlands, France, and Ireland** are considered **outliers:** *While it is to be expected that the macro-based VOLLs will be lower, the Netherlands and France show a much stronger upward divergence compared to other countries and the reported VOLL of Ireland is lower compared to the macro-based VOLL.*

While the **macrodata-based VOLLs** show a consistent and coherent pattern, the **survey-based VOLLs** do not. This hints to differences in **implementation decisions** and the diversity of outcomes inherent to survey method. Additional differences could be caused by variations in load-shedding plans and risk aversion but were not investigated here.

Conclusions: VOLL

- **Large heterogeneity** in the reported VOLLs among the member states that cannot be attributed solely to **structural differences** between countries
- Comparison of reported VOLLs with standardized macroeconomic approach reveals **large interval of relative differences** ranging from -12% to +341% – suggesting that **methodological approaches of the Member States differ** significantly and that **implementation may be partially inadequate**
- **Differences in methodological approaches** of the member states hampering comparability between countries are in part a consequence of the **degrees of freedom** in the ACER methodology
- In addition, the **high complexity** of determining the VOLL repeatedly leads to **inadequate or uncoordinated implementation** of specific parts of the ACER methodology
- **No member state** has implemented the methodology in **every respect**

Conclusions: VOLL

Degrees of freedom within the methodology

Examples driving heterogeneity of results:

- Differences in the **selected sectors** which were surveyed
- Differences in **parameters** (duration, period of occurrence & pre-notification) of outage scenarios
- Varying proportions of **WTP, WTA or direct worth** values used for the VOLL calculation

Lack of coordination/implementation

Examples driving heterogeneity of results:

- Usage of **non-representative samples** within the survey
- Differences in selecting **sectoral weights** used for the VOLL calculation
- **VOLL parameters** outside the specified scope (period of occurrence, pre-notification)
- **No survey-based approach** used for determining the VOLL

Due to the various degrees of freedom and partial lack of implementation, it is difficult to quantify the **effect of individual methodological decisions on the results.**

Based on literature and the insights of individual reports from the member states, **directions and relative importance** of the impact of individual pivotal methodological components have been evaluated.

Recommendations for facilitating future VOLL calculations have been derived (see the following slides).

Recommendations: Further approaches for support

Support Methods for General Challenges

- FAQs style support: List of common questions and their answers related to the implementation of the Methodology
- Best practice example: These examples highlight strategies, approaches, and techniques that have proven effective in overcoming challenges and achieving desired outcomes
- Training workshop: Offering training sessions specifically designed to address challenges in implementing the Methodology and providing hands-on guidance
- Extended Clarifications: Methodology-accompanying document offering extended clarifications and definitions

Support Method for Individual Challenges

- Ad hoc bilateral interactions: Not regular, but as-needed bilateral interactions between the authorities and ACER to ensure that individual queries are addressed effectively.

Recommendations: Approaches for facilitating VOLL calculations

Based on the two findings that the existing VOLL calculations (1) show considerable differences in the methodological approaches between the Member States and (2) individual elements of the existing methodology are inadequately implemented, recommendations were derived to facilitate future VOLL calculations (which may also be combined).

Option 1: Clearer rules instead of a range of options

- Currently, member states have a variety of options in how the VOLL and CONE are determined.
- Existing degrees of freedom within the Methodology could be reduced (e.g. unify estimation to WTP or other method).
- This would improve the comparability of results between member states.
- Creates necessity to determine the "right" approaches for methodological components.

Requires a reduction in the degrees of freedom under the current methodology

Option 2: Coordinated data collection

- Member states are responsible for conducting surveys for determining sectoral VOLLs and further processing into a single VOLL.
- The implementation (and, possibly, the execution and evaluation) of the VOLL-survey could be more coordinated.
- Ensures a similar methodological procedure for all member states as well as efficiency gains.
- Creates a necessity to determine the common denominators + limited and structured national survey elements.

Requires a harmonised approach under the current methodology and additional coordinative efforts

Option 3: Macro-data-based approach

- Currently, the sectoral VOLLs must be determined via surveys.
- Instead, sectoral VOLLs can be calculated using available statistical macro data.
- A robust data basis is already available, which results in a faster calculation at lower cost.
- Certain hidden costs (such as data losses or spoiled food) as well as risk-aversion cannot be taken into account.

Requires the revision of the current methodology

Recommendations: Approaches for facilitating VOLL calculations

Comparison of proposed options*

Evaluation criteria	Current methodology	Option 1: Clearer rules instead of a range of options	Option 2: Coordinated data collection	Option 3: Macro-data-based approach
Degrees of freedom in applying the methodology	High	Low	Low	Low
Complexity of the implementation – due to specific requirements	Low	High	Low	Low
Complexity of the implementation – due to challenging methodological decisions	High	Low	Low	Low
Scope for the consideration of country specifics	High	Low	Low	Low
Consistent implementation for all member states	Low	High	High	High
Challenge to determine the "right" approaches suitable for all Member States	Low	High	High	Low
Resource intensity of the approach	High	High	Low	Low
Time intensity of the approach	High	High	High	Low
Comprehensive consideration of all cost components	High	High	High	Low
Required effort to adjust current methodology	NAP	Low	Low	High

*This comparison does not provide any information on the adequacy of the resulting VOLLs.

Slido - Question 2

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Cost of New Entry and Reliability Standard

Procedure for determining CONE and RS

- **Cost of New Entry** (CONE) – measure used for quantifying the cost of adding incremental capacity in the system to reduce the level of demand disconnections expressed in EUR/MW for each reference technology
- The ACER methodology defines reference technologies as technologies that are able to provide resource adequacy benefits and
  - that can be considered a standard technology
  - and have the potential for new entry
- Calculation of CONE for each reference technology based on techno-economic characteristics

- **Reliability Standard** (RS) – measure used to indicate the necessary level of security of supply of a Member State expressed as the expected number of hours during which capacity resources are insufficient to meet the demand
- The LOLE target for RS shall be the minimum LOLE threshold which fulfils the minimum capacity need for RS

CONE

Necessary components for each reference technology:

- Potential for additional capacity
- Technical characteristics of the reference technologies (type, fuel, emission factors, etc.)
- Investment costs
- Annual fixed costs
- WACC (weighted average cost of capital)
- Variable costs

Reliability Standard

For each reference technology, the best estimate of $LOLE_{RT}$ shall be:

$$LOLE_{RT} = \frac{CONE_{fixed}}{VOLL_{RS} - CONE_{var}}$$

Overview of implementation status of main CONE related components per technology

12 countries calculated CONE	Open cycle gas turbine	Combined cycle gas turbine	Internal combustion engine	Combined heat and power	PV	Wind onshore	Wind offshore	Other generation	DSR	BESS	Pumped hydro	Prolongation
Reference technology identified	9	8	4	4	9	10	6	8	9	10	4	2
De-rating factor	9	8	4	4	8	9	5	6	9	9	3	2
WACC	9	8	4	4	8	9	5	7	9	8	3	x
Capital costs	9	8	4	4	8	9	5	7	9	9	3	x
Annual fixed costs	9	8	4	4	8	9	5	7	8	9	3	2
Potential identified	6	5	2	2	5	6	2	6	7	6	3	1
CONE variable	7	5	3	3	5	6	3	5	8	4	1	1
LOLE threshold	8	5	3	2	6	7	4	7	8	7	2	2
CONE fixed based on Article 15	9	8	4	4	8	9	5	7	9	9	3	2

Color scale per row 

- Example: 9 out of 12 countries defined OCGT as reference technology, 6 countries identified its potential capacity, etc.
- *Other generation* includes: Nuclear, biomass, hydro, emergency power system, and H2 electrolyzers
- Overall, the Methodology regarding CONE has been implemented well with the exception of the non-calculation of the potential of certain reference technologies, which does not follow the Methodology. The exclusion of CONE variable has mostly been justified and thus follows the Methodology.

Conclusions: CONE and RS

- In general the Methodology was largely implemented, main unjustified methodological deviations:
  - No identification of potential for some reference technologies → different reference technologies in some countries were not considered relevant in the determination of the RS
  - Calculation of min. capacity need not based on latest (N)RAA → uncertainties around the definition of the minimum capacity need, lack of knowledge about relations between CONE/RS metrics and resource adequacy assessments, non-availability of an (adequate) NRAA
- Regarding existing numerical outliers in the CONE assessments, comparing different costs per technology across countries is not feasible due to unknown potential differences in types of installations and technical details, especially regarding DSR, PV and storage options (e.g., residential vs. commercial, large scale vs. small scale, roof vs. ground etc.)
- Conclusion:
  - CONE: The clear reporting of technical characteristics and cost components is of high importance for the full understanding of the results and is paramount for a potential comparability among countries
  - RS: Additional support (best practice examples, bilateral interactions, clear definitions, etc.) would enhance the quality of the RS reports, especially regarding the difficulty of the setting the minimum capacity need

Thank you for your participation!

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Q&A session

10:50 - 11:25

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Closing remarks

11:25 - 11:30

Vasilis PAPANDREOU, ACER