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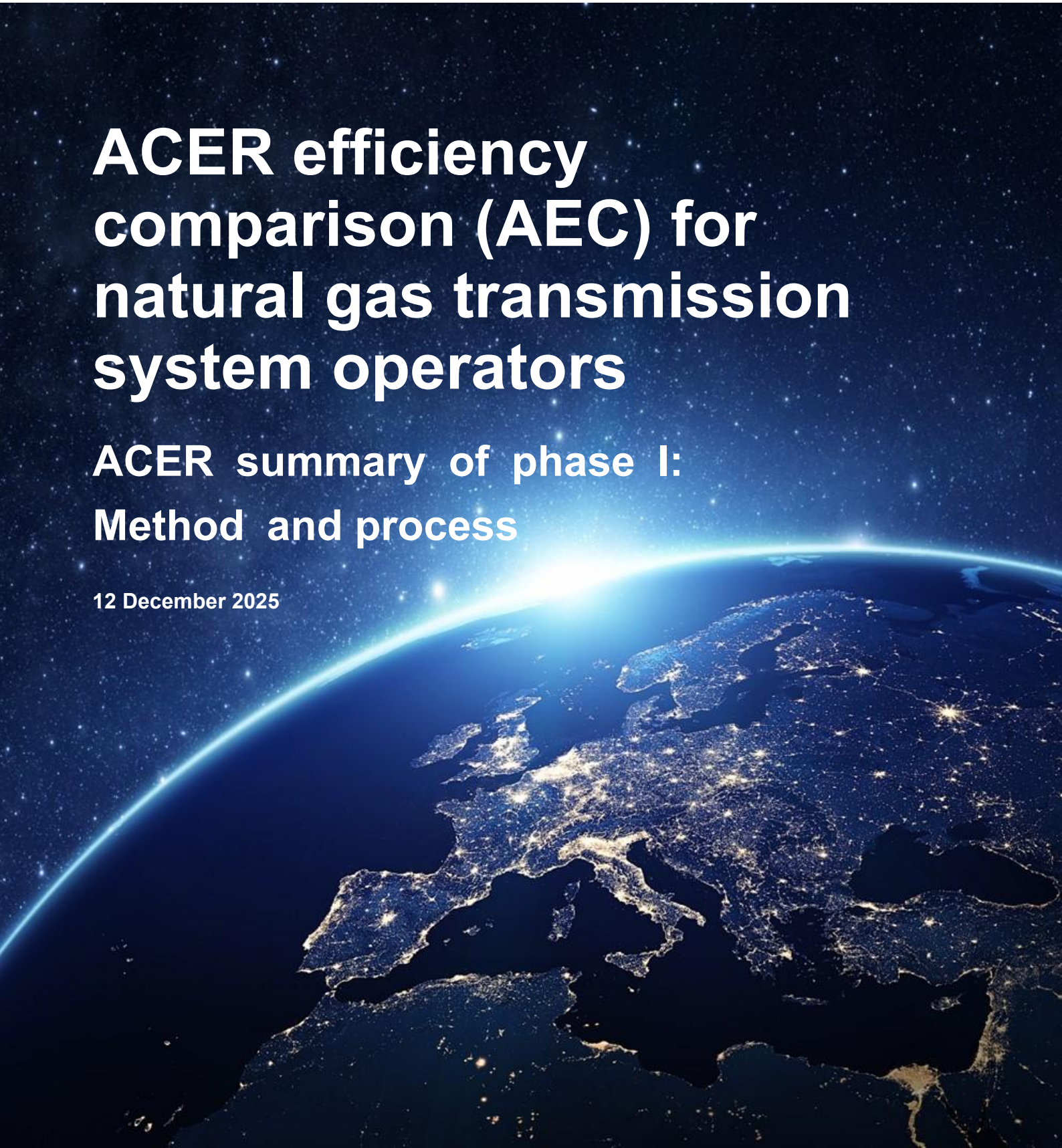
European Union Agency for the Cooperation of Energy Regulators

ACER efficiency comparison (AEC) for natural gas transmission system operators

ACER summary of phase I: Method and process

12 December 2025



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1. Introduction

1 The Agency for the Cooperation of Energy Regulators (ACER) is tasked by Article 19(2) of Regulation (EU) 2024/1789[1] to carry out a study on a cost-efficiency comparison of natural gas transmission system operators' (TSOs) costs.

2 This document summarises the "ACER Efficiency Comparison (AEC): Method and Process" report[2], commissioned by ACER and prepared by SUMICSID GROUP (hereafter 'Sumicsid') and Swiss Economics[3]. It also describes the process leading to the publication of this report and offers insights into the accompanying documents.[4]

2. Disclaimer

3 The AEC Method and Process report is a technical document prepared by Sumicsid and Swiss Economics on behalf of ACER and in collaboration with ACER and national regulatory authorities (NRAs), for guidance in completing the AEC, starting in 2024 and to be published for the first time by 5 August 2027. The report reflects the views of Sumicsid and Swiss Economics and does not necessarily represent the views of ACER. ACER may adapt, modify, or deviate from the methodology, recommendations, or processes proposed in this report.

4 The AEC Method and Process takes into account the proposals presented at a public workshop in Brussels on 9-10 July 2025, which was complemented by a public consultation between 17 June and 17 July 2025 and a review by an independent group of experts commissioned by ACER. The final revised document has been prepared solely by Sumicsid and Swiss Economics, who assume full responsibility for any errors of fact or logic. ACER is not liable for any consequence resulting from the use of information contained in this report.

3. Context

5 The internal market for natural gas aims at delivering competitive prices and higher standards of service, and to contribute to security of supply and sustainability. In this context, gas networks play a crucial role by facilitating the reliable transmission of natural gas across Member States and allowing the integration of renewable energy sources into the system. The existing gas infrastructure was built over several decades and is operated by regulated gas transmission system operators (TSOs). The principle of regulation is based on the requirement of third-party access applied to the infrastructure and access tariffs used to recover network costs. In addition to energy security and environmental sustainability, energy systems also face the challenge to remain affordable. In relation to the affordability of the energy infrastructure, NRAs ensure that the revenue granted to TSOs covers only the costs corresponding to an efficient and structurally comparable TSO, a requirement

[1] Regulation (EU) 2024/1789 of the European Parliament and of the Council of 13 June 2024 on the internal markets for renewable gas, natural gas and hydrogen

[2] AEC Method and Process. Final Report published on 12 December 2025. Link: https://www.acer.europa.eu/sites/default/files/documents/Publications/ACER-2025-TSOs-Efficiency-Comparison.pdf

[3] Direct service contract ACER/NEG/GHR/22/2024.

[4] Accompanying documents:

- AEC Expert Review: Link: https://www.acer.europa.eu/sites/default/files/documents/Publications_annex/2025-ACER-TSOs-Efficiency-Comparison-Expert-Review.pdf
- Annexes to the AEC Method and Process report including the Evaluation of Stakeholder Responses and the Sumicsid Response to the Expert Review. Link: https://www.acer.europa.eu/sites/default/files/documents/Publications_annex/2025-ACER-TSOs-Efficiency-Comparison-Appendix.pdf

set in Article 17 of Regulation (EU) 2024/1789. In this context, the AEC will become a key tool to calculate efficiency scores to be used by NRAs when setting the regulated revenue EU gas TSOs. In addition, the AEC will support NRA decisions in the context of decarbonisation; where network utilisation is expected to decrease, potential tariff increases require close monitoring to assess possible regulatory responses.

6 NRAs set the allowed or target revenue of TSOs which is an input for calculating tariffs for transmission networks. The Network Code on Harmonised Transmission Tariff Structures for Gas[5] (NC TAR) establishes requirements for NRAs when setting tariffs for transmission services at network points of an entry-exit zone.

7 The likely decrease of gas consumption will require recovering the costs of the system among a smaller user base. This could lead to a significant increase of transmission tariffs for final consumers, possibly, making the recovery of transmission infrastructure costs more challenging. Therefore, it is important to promote greater transparency regarding the allowed or target revenue methodologies compensating gas TSOs. The actual costs that TSOs incur shall be closely monitored and their efficiency assessed, where margins exist for efficiency gains. Moreover, the AEC will support future decisions related to natural gas networks such as the transfer of assets from a natural gas TSO to hydrogen transmission network operators (HTNO) and the choice to extend or replace assets (reinvestments).

8 Up to 2025, a regular cost efficiency benchmark has been carried out by the Council of European Energy Regulators[6] (CEER) for both gas and electricity networks (TSO Cost Efficiency Benchmark, 'TCB'). Participation in this project has been established as voluntary and some NRAs decided not to participate. Three assessments have been delivered in 2016 (E2Gas)[7], 2019 (TCB18)[8] and 2025 (TCB21)[9].

4. Legal basis

9 Article 19 of Regulation (EU) 2024/1789 tasks ACER to carry out an efficiency comparison of gas TSOs, the results of which should then be taken into account by NRAs when periodically setting the allowed or target revenue. The AEC is a mandatory benchmark for all European gas TSOs. The goal of the benchmark is to provide an efficiency comparison for each EU gas TSOs.

10 To ensure proper coordination in collecting and interpreting data for a transparent and reproducible efficiency comparison study, the relevant NRAs and the TSOs shall provide ACER with all the data necessary for that comparison. Article 19 of Regulation (EU) 2024/1789 establishes:

> *The costs of the TSOs shall be subject to an efficiency comparison between TSOs. ACER shall carry out that efficiency comparison. By 5 August 2027 and every four years thereafter, ACER shall publish a study comparing the efficiency of TSOs' costs, subject to the protection of data considered by ACER to be commercially sensitive. The relevant regulatory authorities and the TSOs shall provide ACER with all the data necessary for that comparison. When periodically setting the allowed or target revenue of TSOs, the relevant regulatory authorities shall take into account such comparison and national circumstances.*

[5] Commission Regulation (EU) 2017/460 of 16 March 2017 establishing a network code on harmonised transmission tariff structures for gas.

[6] See CEER's Report on Regulatory Frameworks for European Energy Networks 2024. Link: https://www.ceer.eu/publication/report-on-regulatory-frameworks-for-european-energy-networks-2024/ In addition, see ACER's 2018 Report Methodologies Target Revenue of Gas TSOs: https://www.acer.europa.eu/sites/default/files/documents/Publications/ACER%20Report%20Methodologies%20Target%20Revenue%20of%20Gas%20TSOs.pdf, and https://www.acer.europa.eu/sites/default/files/documents/Publications/Consultant%20Report.pdf

[7] https://www.ceer.eu/publication/e2gas-benchmarking-european-gas-transmission-system-operators/

[8] https://www.ceer.eu/wp-content/uploads/2024/04/TCB18_final_report_gas_190717.pdf

[9] https://www.ceer.eu/publication/tso-cost-efficiency-benchmark-tcb21-model-specification-gas/

11 When taking into account the results of ACER's Efficiency Comparison, NRAs should comply with the requirement under Article 17 of Regulation (EU) 2024/1789 which establishes that "*tariffs, or the methodologies used to calculate them* […] shall *reflect the actual costs incurred, insofar as such costs correspond to those of an efficient and structurally comparable network operator".*

12 The AEC will additionally support NRAs in meeting the requirement under Article 19(3) of Regulation (EU) 2024/1789 to assess the long-term evolution of transmission tariffs. For this task, NRAs should consider the expected changes in the allowed or target revenue of the TSOs and in natural gas demand within the relevant regulatory period, and, where available until 2050. To conduct this assessment, the regulatory authority shall include the information about the strategy described in the integrated national energy and climate plan of the Member State concerned and the scenarios underpinning the ten-year network development plan as developed in accordance with Article 55 of Directive (EU) 2024/1788. The AEC can provide valuable information on the development and relative efficiency of TSO costs over time.

13 Additional transparency on cost efficiency will support the NRAs' regulatory decisions in the context of decarbonisation including repurposing for the transport of hydrogen, potential decommissioning, reinvestments and network planning.

5. Process

14 The work to complete the first publication of the AEC by 5 August 2027 is being built gradually by ACER. The first phase of this work has been completed between December 2024 and December 2025. The resulting AEC Method and Process report by Sumicsid supports ACER to complete phase II and III of the AEC.

15 The second phase of the work will start in January 2026 and will last until the last quarter of 2026. It will focus on data collection and validation. This process is described in section 7 below. Finally, the third phase will be completed between the last quarter of 2026 and August 2027 when the results of the efficiency comparison across gas TSOs will be published. This process is summarised in the figure below:

16 Phase I leading to the publication of the AEC Method and Process report has included three rounds of input: a public consultation carried out between 17 June and 17 July 2025, a stakeholder workshop in Brussels on 9-10 July 2025, and an independent expert review of the AEC consultation documents executed in the course of August and September 2025. These interactions have aimed at improving the method design.

17 Considering a frequency below four years for the publication of the benchmark can potentially facilitate the adoption by NRAs. ACER will take a decision on the design of future iterations of the AEC, including the publication frequency, following its first publication by 5 August 2027. The decision will build on the experiences and the resources required across the parties involved in the publication of the first AEC.

18 The AEC Method and Process report discusses the possible process options after 5 August 2027 under section 15.

5.1. NRA workshop

19 ACER and NRAs have held continuous exchanges to discuss the methodology of the AEC that led to the documents which were open for public consultation. As part of these exchanges, ACER organised a two-day NRA workshop on 31 March and 1 April 2025.

5.2. Public consultation

20 ACER carried out a public consultation between 17 June and 17 July 2025, seeking stakeholders' views on two documents:

- AEC Objectives and Criteria. Synthesis Report D02.
- AEC Method, Data and Process Synthesis Report D02.

21 The responses received have been published[10] in addition to their evaluation[11].

5.3. Stakeholder workshop

22 ACER organised a stakeholder workshop[12] to present and discuss the consulted documents. The workshop was carried out in Brussels on 9-10 July 2025.

5.4. Expert Review

23 ACER has commissioned a group of independent experts to review the documents subject to the public consultation. The experts were appointed by ACER[13] according to their competence related to their knowledge of the EU gas sector, gas TSO regulation and benchmarking. Their competence was appreciated both in academic and professional capacities. The group of experts has been considered by ACER to hold the adequate expertise to provide a critical assessment of the AEC and to offer possible improvements.

24 The following members were part of the Expert Review:

- Prof. Dr-Ing. Joachim Müller-Kirchenbauer, Technical University Berlin.
- Prof. Dr. Mette Bjørndal, Norwegian School of Economics and Management.
- Prof. Dr. Tooraj Jamasb, Copenhagen Business School.
- Prof. Dr. Anne Neumann, Norwegian University of Science and Technology.
- Prof. Dr. Luis Orea, University of Oviedo.

[10] ACER Public consultation on the ACER gas TSO cost efficiency comparison draft methodology, PC_2025_G_04. Link: https://www.acer.europa.eu/public-consultation/pc2025g04-public-consultation-acer-gas-tso-cost-efficiency-comparison-draft-methodology

[11] See footnote 4.

[12] Stakeholder workshop. Link: https://www.acer.europa.eu/public-events/workspace/workshop-acers-new-cost-efficiency-comparison-eu-gas-tsos

[13] The Agency invited to tender five (5) experts with the aim to sign five (5) direct service contracts for the review of the methodology and process design for carrying out an efficiency comparison of European Gas Transmission System Operators for the Agency, as follows: Procurement procedure no. ACER 2025 VLVP 0039; Ref. no. Ares(2025)620705; Procurement procedure no. ACER 2025 VLVP 0041; Ref. no. Ares(2025)6209207; Procurement procedure no. ACER 2025 VLVP 0043; Ref. no. Ares(2025)6209103; Procurement procedure no. ACER 2025 VLVP 0044; Ref. no. Ares(2025)6208984; Procurement procedure no. ACER 2025 VLVP 0045; Ref. no. Ares(2025)6208448.

25 The Expert Review was tasked to assess the AEC documents that were subject to public consultation in summer 2025. The analysis completed by the group assesses the adequacy of the draft AEC design proposal as a state-of-the-art approach in efficiency assessments for energy regulation in Europe considering regulatory, economic and legal constraints as well as the feasibility, correctness, applicability and usefulness of the proposal.

26 Between August and September 2025, the group of experts held exchanges with ACER and presented its results to ACER, national regulatory authorities (NRAs) and to Sumicsid. This input has been taken into account when drafting the final AEC Method and Process report, as discussed in Appendix C of the AEC Method and Process report. [14]

5.5. Interactions with ENTSOG and TSOs

27 ACER has organised several exchanges with ENTSOG and TSOs across phase I of the AEC.[15] During these exchanges, ACER extended a request to TSOs to investigate the characteristics of certain cost elements to determine the best approaches to treat these costs in the AEC. These costs included labour costs in outsourced services, labour costs as part of Capex and costs related to enabling hydrogen readiness for natural gas infrastructure.

28 ACER notes that ENTSOG and TSOs did not provide any input to this request. ACER will therefore carry out this analysis based on the information to be requested to TSOs during the second phase of the AEC.

6. AEC Methodology

29 The AEC Method and Process report is a synthesis of the two documents consulted on by ACER and reviewed by a group of experts.

30 The AEC Method and Process report provides general guidance for ACER in designing the methodology and procedures for phase II (data collection and validation) and phase III (modelling) of the AEC. However, in implementing these phases, ACER may adapt, modify, or deviate from the proposals and recommendations outlined in the report as deemed necessary.

6.1. Objectives and scope

31 The AEC Method and Process report identifies the main changes in the natural gas market affecting natural gas transmission networks in the upcoming decades:

- Decrease in natural gas volumes consumed and transported.
- Growing importance of new forms of gas, biogas and LNG, potentially leading to network reinforcements.
- Planned development of hydrogen networks possibly resulting in the removal of some existing gas assets and in the obsolescence of others.
- Maintenance of existing networks requiring extending or replacing assets that reach the end of their technical operating life.

[14] The main changes compared to the proposal subject to consultation include, first, the distinction between primary and secondary methods was changed to establish an equal weight of SFA and DEA in the execution-based model. Second, the use of time-series (panel data) was added to the AEC models, also for calculating single-year (static) scores. Third, the use of general scaling functions was added to complement or replace the NormGrid. Forth, the proposed returns to scale assumption (increasing returns to scale) were replaced with a requirement to investigate the returns to scale in the data.

[15] Calls were organised on 13 December 2024 to discuss the kick-off of the project and on 9, 15 and 28 May 2025 in preparation of the Stakeholder Workshop held on 9-10 July 2025.

32 Based on these challenges, the AEC Method and Process report discusses the potential role of an efficiency benchmark. Efficiency can relate to network planning, to the execution and operation of investments, and to the utilisation of the network. Based on this, the AEC distinguishes two different approaches to measure efficiency.

33 An execution focus assesses the tasks that are directly controlled by TSOs, which include construction, operation and maintenance of network assets put at the network users' disposal. It does not depend on the network planning outcomes (planning efficiency), the asset intensity, the dimensions of the network or the delays in finishing projects (planning efficiency). Nor does it consider the (actual) utilisation of the assets, resulting from demand or supply variations.

34 A utilisation focus, on the contrary, compares the cost and investments for transport related to the planning and use of assets for capacity and transport. It incentivises TSOs to the full utilisation of assets and the rapid decommissioning of unused assets. Inversely it penalises TSOs where demand is growing more slowly or decreasing. This regulatory approach exposes the TSOs to a market risk and disincentives investments. Given the interest in providing a stable business environment avoiding hindsight evaluations, most regulatory benchmarking in Europe is execution-based, meaning that the efficiency does not take into account the extent to which the infrastructure is used.

35 The AEC adopts a two-fold approach to measure efficiency.

- First, it measures the efficiency of the execution-based tasks of the TSO. An operator that makes poor preparations, costly and ineffective tendering and inadequate maintenance interventions will show up as having an execution-based inefficiency compared to best-performing TSOs. For many TSOs, the primary sources of inefficiency come from operational management and procurement activities, leading to lower staff productivity, high outsourcing costs, as well as high equipment, installation, and siting costs due to choices related to the costs of kits, suppliers, standards, timing and locations.
- Second, the AEC will additionally provide a dynamic assessment of efficiency taking into account network utilisation over time.

36 Based on these two approaches, the AEC enables the following uses of efficiency:

- ***General efficiency factors calculated for every year.*** The execution focus of AEC provides NRAs with efficiency factors that can be used both in cost-based and incentive-based regulation in the short and medium-run. These factors are calculated for Totex and further disaggregated for Capex and Opex.
- ***Dynamic improvement incentives.*** The use of dynamic efficiency allows for the decomposition of general efficiency changes into technical progress and efficiency catch-up. These factors can help improve the relative position of inefficient TSOs while ensuring that the most efficient TSOs continue improving.
- **Incentives for asset extensions**. The AEC model can adjust the value of Capex to reflect the benefits of prolonging the use of fully depreciated assets during the energy transition. This allows the AEC to provide incentives to avoid asset replacements, subject to the technical feasibility of these extensions.
- ***Incentives for decommissioning.*** By default, the AEC model is neutral to decommissioning unused assets when removed using the residual RAB value. However, in specific modelling runs, NRAs can request incentives for decommissioning as part of the AEC.
- ***Prevent perverse incentives for repurposing.*** There may be perverse incentives for TSOs to sell or transfer pipeline assets with inefficiently high investment values to hydrogen operators. As part of the AEC, asset transfers are reported separately and monitored for the original value and compared to mean unit-cost values.
- ***Utilisation incentives.*** The utilisation-based model can be used to monitor the asset utilisation for a TSO over time, controlling for random factors in volume and capacity load. This can assist NRAs in the dialogue with TSOs on decommissioning, repurposing and/or new investments during the transition period to 2050. This model can also be used to forecast future utilisation loads and asset use, which in turn may improve the effectiveness of TSOs.

- ***Sector transparency and accountability***. Overall, the AEC provides objective and harmonised cost efficiency comparisons across EU gas TSOs. Stakeholders (governments, investors, consumers) can use AEC data to monitor the costs and efficiency of gas infrastructure in the context of decarbonization.

37 The input received from stakeholders shows a broad consensus on the challenges ahead in the context of decarbonisation. The input received in relation to the use of utilisation parameters is discussed in 6.3.3 and 6.3.4 below.

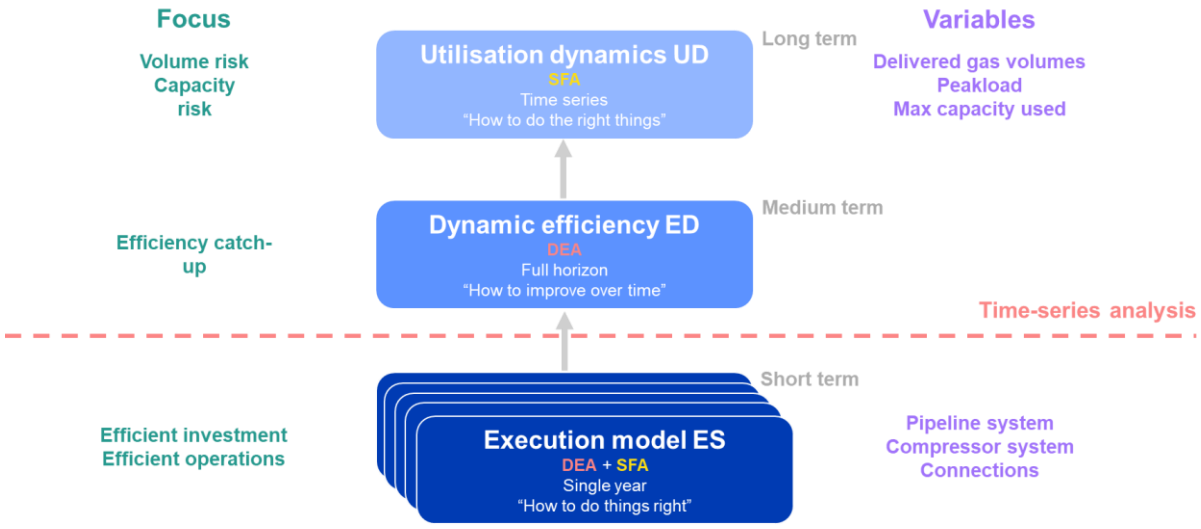
6.2. Methodology design

38 The AEC Method and Process report proposes three different benchmarking models:

- First, an execution-based model (ES) providing static results for individual years.
- Second, an execution-based model (ED) providing dynamic results over a period (e.g. 4-5 years).
- Third, a utilisation-based model (UD) providing dynamic results with a view to assessing the impact on the long-term.

39 These three models are summarised in Figure 1 and are further described in the following sections.

Figure 1: Models execution static (ES), execution dynamic (ED), and utilisation dynamic (UD).



40 As a complement, the AEC will derive unit cost, and key performance indicators (KPIs) for use by NRAs and TSOs.

6.2.1. Execution-based model providing static results (ES)

41 The main result of the proposed AEC model is a static (one-year) efficiency model which primarily relies on asset-based outputs (and not utilisation-based outputs). The main efficiency metric is cost efficiency (CE) for all operators, which requires standardised definitions of inputs and outputs across operators. Cost efficiency is also decomposed in two partial inputs (Opex and Capex), referred to as CE(2).

42 The AEC Method and Process report proposes to use both data envelopment analysis[16] (DEA) and stochastic frontier analysis[17] (SFA) in the efficiency analysis for the Execution Static model (ES), using primarily deterministic, asset-based data. DEA is a strong reliable methodology for heterogenous deterministic data of medium size, without a priori assumptions on cost functions. The use of DEA for benchmarking TSOs is well established and has been used in CEER's TSO Cost Efficiency Benchmark (TCB18, TCB21 and E2GAS) and also in the German benchmark for gas TSOs.[18] SFA is a powerful analysis tool to understand the causes and development of efficiency in a sector, impact of exogenous environmental factors and time, as well as uncertainty. SFA has been used in thousands of academic studies of productive efficiency as well as in gas transmission analyses in EU, USA, South America.[19]

43 NRA practices and academic research show clear advantages when combining parametric and non-parametric methods in regulatory applications as discussed in section 8.13 of the AEC Method and Process report. This practice allows for cross-validating results and mitigating the effects of model assumptions. The combination of methods supports the legal defensibility of the methodology in case the use and/or the application of the efficiency comparison is appealed.

44 In an environment of a decreasing use of the infrastructure having utilisation metrics in a benchmark implies that TSOs are rewarded (or penalised) for bringing the size/capacity of the network in line with decreasing demand. For this reason, the ES model in AEC will use primarily asset-based outputs instead of utilisation-based outputs to compare controllable and foreseeable factors.

45 The ES model focuses on a single year and uses variables that are not subject to random effects, primarily execution-based outputs and services directly derived from installed assets, potentially including environmental correction factors. The analysis is not sensitive to cost changes over time across Europe. The results are provided for Totex and are disaggregated for Capex and Opex. The ES model is described in sections 6.2, 8.9 and 8.10 of the AEC Method and Process report.

46 The combination of two methods results in two efficiency scores which can be used separately or combined by NRAs, as discussed in section 8.13 of the AEC Method and Process report.

6.2.2. Execution-based model providing dynamic results (ED)

47 The proposed AEC model additionally allows to compare the static results over time and to derive the technological progress and catch-up effects of TSOs. Efficient operators will push the frontier and achieve performances that were previously unattainable. Other operators will catch up, adopting best practices and improving their efficiency.

48 As technologies are continuously changing, it is important to identify, in a dynamic model, the impact of technological progress on the frontier and how the relative efficiency of the TSOs evolves over time. The frontier shift results represent the mean technological progress of the sector and can be used in NRAs' revenue decisions. The model is discussed in sections 6.2, 8.9 and 8.11 of the AEC Method and Process report.

[16] For an overview of scientific literature, see e.g. Afsharian, M., Ahn, H., & Kamali, S. (2022). Performance analytics in incentive regulation: A literature review of DEA publications. Decision Analytics Journal.

[17] Aigner, D. J.; Lovell, C. A. K.; Schmidt, P. (1977).Formulation and estimation of stochastic frontier production function models. Journal of Econometrics. 6: 21–37.

[18] Swiss Economics, Sumicsid, 4Management (2018) Kostentreiberanalyse und Effizienzvergleich der Gasfernleitungsnetzbetreiber EFG3, Final report for Bundesnetzagentur.

[19] Lampe, H. W., & Hilgers, D. (2015) survey DEA and SFA publications jointly, covering contributions published in journals, indexed by the Web of Science database from 1978 to 2012. Overall, 4782 publications were included in the dataset, 761 for SFA and 4021 for DEA. See: Lampe, H. W. & Hilgers, D. Trajectories of efficiency measurement: A bibliometric analysis of DEA and SFA. Eur. J. Oper. Res. **240**, 1–21 (2015).

6.2.3. Utilisation-based model providing dynamic results (UD)

49 ACER acknowledges that the sizing of the network in view of the utilisation of the network (*utilisation focus*), is key in the context of decarbonisation. The energy transition is expected to result in lower demand for natural gas over time. The evolution of demand and entry points depend on many factors, most of them being uncontrollable by TSOs, as networks are sized to match peak network use.

50 To provide information on, and incentives for, the correct asset intensity facing fuel substitutions, the proposed AEC model incorporates a dynamic utilisation model, covering several years of operations. In this case, to monitor the volume transported and peak load development in the natural gas sector and the adaptation of assets to outputs, usage-based outputs will also be used. The inclusion of usage-based outputs in the dynamic model captures how TSOs can adapt to changing circumstances.

51 For this calculation, the AEC Method and Process report proposes to use SFA. The UD model is proposed as the method for the dynamic (multi-year) analysis using stochastic models with both assets, usage and contextual-environmental factors included. SFA is not only the academically most used dynamic method, but also and foremost, a tool to explore and address random variables or data errors in the AEC. This approach is discussed in sections 6.2, 6.4, 7.8, 8.1, 8.4, 9.4 and 13.1 of the AEC Method and Process report.

6.3. Key design features and stakeholder input

52 The following section refers to key design features of the AEC taking stock of the discussions held between ACER, NRAs, and Sumicsid as well as the input provided by stakeholders to the process and the conclusions of the Expert Review.

6.3.1. Repurposing, decommissioning and reinvestments

53 The AEC Method and Process report proposes to measure the efficiency of TSOs in the context of decarbonisation. The 2022 DNV report[20] commissioned by ACER identifies the main challenges faced by TSOs in the upcoming decades, which relate to repurposing, decommissioning and reinvestments. ACER requested input from stakeholders in the public consultations, with the respondents confirming the importance of the challenges identified.

54 In relation to repurposing and decommissioning, the proposal subject to consultation adopted a neutral stance in relation to the removal of TSO assets. Assets removed from the RAB using the residual asset value[21], would have no impact on the efficiency scores.

55 At the same time, the Expert Review emphasised the importance of providing instruments to coordinate and incentivise the potential removal of TSO assets from the regulatory asset base (RAB), be it for repurposing or decommissioning actions.

56 ACER has followed this recommendation by allowing to implement efficiency incentives in the AEC calculation when removing assets from the RAB. Incentives can be included upon the specific request of NRAs that would be reflected in the individual scores of TSOs. These calculations would not impact the overall scores of other TSOs. The use of such incentives should be consistent with other regulatory instruments in place. This approach is discussed in section 6.3, 9.2 and 9.3 of the AEC Method and Process report.

57 In relation to reinvestments, the AEC model provides incentives not to replace assets that have been fully depreciated and to extend their asset lives. These measures should be coordinated across the

[20] ACER (2022) Future regulatory decisions on natural gas networks: repurposing, decommissioning and reinvestments. Link: https://www.acer.europa.eu/sites/default/files/documents/Media/News/Documents/Future Regulation of Natural Gas Networks - Final Report DNV.pdf

[21] See Article 5 of Regulation (EU) 2024/1789.

regulatory instruments used by NRAs to ensure the consistency of the regulation. This approach is discussed in sections 6.3 and 10.4 of the AEC Method and Process report.

6.3.2. Legacy investments

58 The efficiency of natural gas TSOs is largely impacted by legacy investments carried out prior to the liberalisation of the EU gas natural gas sector. Past investments, prior to deregulation, might not always have been undertaken with an efficiency focus. For instance, these investments may have been prompted by other owners in integrated utilities or for national security or non-economic reasons. Furthermore, investments prior to EU-membership are in some cases subject to hyperinflation or non-market prices for labour or equipment.

59 These observations, which are valid for gas TSOs and are important for incentive regulation of future investments and operations, call for a periodised analysis of the past Capex. ACER considers it informative to analyse the impact of legacy investments by providing results both, with legacy investments and controlling for legacy investments. The proposed approach is discussed in section 10.5 of the AEC Method and Process report.

60 ACER proposed in the public consultation the year 1998 as the cut-off date to identify legacy investments, when Directive 98/30/EC[22] (First Gas Directive) entered into force. In the responses to the public consultation and in the input provided at the workshop, stakeholders pointed out that the accession date of some Member States occurred after this date. Following these remarks, ACER has adjusted the cut-off date to the entry into force of the First Gas Directive or to the accession date to the EU when this date is beyond 1998.

6.3.3. Choice of DEA and SFA models

61 The choice of benchmarking models is a core element of the AEC Method and Process report. For this decision, ACER has aimed at ensuring the robustness of the AEC Method and Process report, including for legal review and appeals in court. ACER has also aimed at ensuring transparency, allowing for the reproduction and interpretation of the results, thereby preventing the black-box effect pointed out regarding TCB18 and TCB21 by participants in the project. These objectives are largely supported in the input provided by stakeholders to the public consultation.

62 Initially, in the publicly consulted documents, ACER proposed the use of DEA and SFA in both a static and dynamic configurations. This approach received criticism during the stakeholder workshop and in the Expert Review for not being conceptually robust.

63 To address this criticism, ACER has adjusted the models as presented in section 6.2 above. These models are characterised in sections 8.3, 8.4, 8.6, 8.7 and 8.13 of the AEC Method and Process report, including by providing examples of the application and results calculated on a dataset of US natural gas pipelines for each model (ES, ED, UD) using the proposed methods (DEA and SFA, DEA, SFA respectively).

64 ACER acknowledges the comments provided by ENTSOG, which point out that any EU-wide comparison is highly theoretical and is subject to simplifications and assumptions. In contrast market parties and consumer associations support the use of benchmarking as well as the proposed methods as means to measure the efficiency of TSOs.

6.3.4. Utilisation parameters

65 The use of exogenous parameters as part of the AEC has been thoroughly discussed across the AEC phase I. TSOs have emphasised in their input to the process that utilisation parameters are beyond the control of TSOs and should not be included as part of the modelling. At the same time, ACER refers to the input received from market parties and consumer association, which support the

[22] Directive 98/30/EC of the European Parliament and of the Council of 22 June 1998 concerning common rules for the internal market in natural gas.

use of dynamic analysis to extend the analysis of efficiency beyond the activities under the control of TSOs (i.e. network planning).

66 The AEC Method and Process report adopts a twofold strategy addressing both perspectives by developing two different approaches: an execution focus (ES and ED models) and a utilisation focus (UD model). These aspects are discussed in sections 6.2, 6.4 and 8.9 of the AEC Method and Process report. The adoption of utilisation parameters is specifically discussed in sections 13.1 and 13.3. The questions related to the interpretation and potential use of the UD model results in regulation will be subject to later information by ACER.

6.3.5. Reference data (panel data, multi-year data, cross-section data)

67 The datasets established for each of the ES, ED and UD are further discussed in section 8.8 of the AEC Method and Process report.

68 The Expert Review pointed out the value of using the complete panel dataset (all observations) for developing, testing and calculating average cost functions with the highest precision. The dynamic models should also use the full data set, transparently identifying and removing potential outliers from the dataset using the methods proposed in the report.

6.3.6. TSO comparability

69 TSOs operate in environments that are specific to them as they are exposed to different market, geographic and regulatory conditions. The AEC should take into account this specificity and enable a proper comparison between the different TSOs.

70 In relation to the RAB, NRAs apply different regulatory parameters to the different categories of assets (working capital, assets under construction, leased assets and assets partially financed by third parties). As a result, the composition of the RAB varies from one country to another. For the benchmarking exercise, it is necessary to have a measure that allows comparing the RAB by creating a certain level of uniformity. This requires defining the scope of the analysis to focus it on comparable Capex input. To address these issues, the AEC defines:

- A method to transform nominal investment values in national currencies to real annuities (Capex) in a common currency (EUR).
- The scope of investments considered in the perimeter of the benchmark, controlling for joint ownership or operation of assets, age, activation status, structural and organizational differences.
- A method to ensure comparability of investments included in the perimeter by standardising and or controlling for capital costs, labour costs, overhead cost allocation, inflation, opening balances and price and currency differences.

71 Regarding the cost of capital, the AEC Method and Process report proposes to use standardised methods across all TSOs. In addition, a specific model run is proposed using the national cost of capital for each TSO and NRA to study potential distortive effects of differences in financial cost on asset structure and staff intensity[23].

72 Section 10 and 11 of the AEC Method and Process discusses the approaches to ensure the comparability of TSOs.

73 The input received in the public consultation shows varying levels of support for the approaches proposed to ensure comparability. In general, TSOs have criticised the approach as incomplete and only relevant as a theoretical exercise. In contrast, market parties and the Expert Review have supported the proposed approach to enable the comparability of TSO costs. All stakeholders, in addition to the Expert Review, have supported the need for accurate data and transparency.

[23] At the same cost of labour, a lower cost of capital makes investments more attractive than employment of labour. If the cost of capital is excessive, the opposite is true. One may therefore expect lower than optimal labour productivity.

74 The measures to ensure comparability, including the application of indexes, scaling factors and standardisation, will be further detailed and discussed as part of a third phase when the modelling and efficiency results of the AEC will be provided.

6.3.7. Output parameters and scaling functions

75 A comparison of the efficiency of gas transmission system operators using the methods of DEA and SFA requires different types of variables. TSOs have different pipeline systems which show heterogeneity across material choices, dimensions, and ownership. In addition, some TSOs have regional networks[24] as part of their assets. When creating output variables, a question arises about how to aggregate assets to make them comparable. The AEC Method and Process report proposes the use of different instruments, including scaling functions (such as the NormGrid[25]), to aggregate TSO outputs (see chapter 13 and specifically section 13.4 of the AEC Method and Process Report).

76 The comments received during the stakeholder workshop and in the Expert Review pointed to the need of additional transparency on the calculation of the scaling functions used in the Normgrid.

77 In response to these comments, the AEC will explore, during phase III, the use of the NormGrid in parallel with other scaling functions that are available as part of regulatory and academic practice.

78 The robustness of the chosen scaling function will be explored through a sensitivity analysis using one or several alternative cost functions as discussed in section 8.16 of the AEC Method and Process report.

6.3.8. Environmental and structural factors

79 Environmental factors are conditions that may have an impact on the cost of providing services (Capex and/or Opex). The AEC proposes corrections across multiple factors, including land use, slope, soil properties and wetness based on spatial asset locations, as well as excluding costs and investments that are out-of-scope.

80 Corrections for environmental conditions are a key feature explaining residual cost differences after the initial adjustments for structural, economic and technical heterogeneity. The exact implementation will depend on the granularity of the locational data of the TSO assets in the data collection and validation.

81 In the input received from the Expert Review, the parameters selected and the approach for testing the environmental effects were supported as sound and essential for comparing between gas TSOs. The Expert Review strongly emphasised the need for locational data to estimate the complexity of investment and operation in individual gas networks.

6.3.9. Regional networks

82 Some TSOs have regional networks as part of their assets. However, these assets are sometimes considered together with other transmission assets and other times receive a separate regulatory treatment. A question has been raised to ACER about whether these regional assets could be made comparable to transmission assets in the AEC.

83 The proposed AEC methodology includes instruments to compare assets of different characteristics (e.g. pipelines of different diameters) such as the use of an estimated normalised grid or of scaling functions such as those provided by NormGrid or by other peer reviewed and published studies. This approach can address these differences enabling the comparability of TSOs and is discussed in sections 10 and 11 of the AEC Method and Process report, with regional networks specifically discussed in section 13.5.

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[24] See Chapter 5 of 2020 ACER report, The Internal Gas Market in Europe: The Role of Transmission Tariffs. Link: https://www.acer.europa.eu/sites/default/files/documents/Publications/The%20internal%20gas%20market%20in%20Europe_The%20role%20of%20transmission%20tariffs.pdf

[25] The NormGrid is a cost-weighted sum of network components. It enables a comparison of different assets based on their costs.

6.3.10. Service quality

84 ACER has consulted NRAs, TSOs and stakeholders on the assessment of service quality for gas transmission. Some users have called for the integration of customer satisfaction surveys or similar queries as proxies for service quality. At the same time, it has been generally acknowledged that this would bring subjective and heterogeneous data into the process.

85 The Expert Review noted that the quality requirements for gas networks are fundamentally different from those applied to electricity grids. While electricity grids need continuous and reliable connection internally and externally, gas networks are linked to central storage, port facilities and load with decentralised storage. Thus, indicators such as SAIDI (mean duration of interruption) and SAIFI (mean frequency of interruptions) have little relevance for gas networks. The remaining aspects that could be considered are safety and security, but these events are highly stochastic and not relevant for incentive regulation.

86 ACER will decide on the possible integration of quality indicators in the benchmarking as part of phase III.

7. Data collection and validation

87 Phase II of the AEC will focus on the data collection and validation. The data used of the AEC will be based on the data request used in TCB21 with minor amendments, as pointed out in Appendix E of the AEC Method and Process report.

88 The experience of TCB21 was that the effort to validate the TSO data differed across NRAs. To ensure that a high-quality dataset is available, a careful and multi-level data validation is necessary. This includes a financial audit of the data submitted and several validation rounds by NRAs and by the consultant that will be responsible for carrying out this second phase of the AEC. The validation carried out by the consultant will allow a cross-validation analysis in addition to technical validation performed by engineering support. The validation process can be complemented with a final report documenting the cross-validation steps, findings and corrective actions.

89 Stakeholders have supported the proposed measures to ensure the appropriate quality of the data.

8. Transparency and commercially sensitive data

90 ACER will promote transparency on the AEC to enable access to the TSO data used in the modelling. This will allow transparency over NRA decisions. Without a transparent process for data collection, methodology, calculations and reporting, the value of the AEC for NRAs is low. At the same time, any data that ACER considers commercially sensitive shall be protected.

91 ACER will approach the publication using a multi-tier transparency model:

- Data that is used for the AEC calculation, which is not submitted by TSOs and is publicly available (T0 data) will be subject to open access. This includes, for example, inflation and labour indexes used to standardise TSO cost data.
- All the data used to compute the AEC results (T1 dataset) will be publicly disclosed, including the final efficiency results for each TSO.
- A third dataset, including commercially sensitive data, will not be made public (T2 dataset).

92 To ensure transparency, AEC should maintain the following principles:

- Clear established data definitions and data specifications prior to the data collection.
- Independent audits of financial and asset data for each TSO.
- Open access to the T1 dataset which should be non-commercially sensitive (see Appendix D of the AEC Method and Process report).

- The methodology should be documented in a reference document that is independently validated by experts prior to calculations.
- Calculations and reporting of results should be independently audited by a third party.
- The individual reporting should specify each step in the process as to enable each NRA to reproduce the input data.

93 At the same time, ACER will ensure that the information that will be published is not commercially sensitive for TSOs. Article 19(2) of Regulation 2024/1789 requires that ACER assesses the commercially sensitive condition of the data prior to the publication of the AEC.

94 With this approach, ACER intends to avoid a black-box effect for which prior benchmarking projects have been criticised and, in some cases, appealed at national level. ACER intends to offer a disclosure of the modelling data to allow TSOs scrutinising the AEC calculations across peers, in addition to further allow stakeholders to understand the efficiency of TSO costs. Furthermore, ACER invites NRAs to support the Agency throughout this process to ensure the establishment of a successful design.

95 All stakeholders support high transparency standards along the AEC process. Complementary to this, TSOs call for the importance of protecting any information considered commercially or security sensitive.