

**OPINION No 08/2023**  
**OF THE EUROPEAN UNION AGENCY**  
**FOR THE COOPERATION OF ENERGY REGULATORS**

**of 25 September 2023**

**on the draft ENTSOG cost-benefit analysis methodology of hydrogen  
infrastructure projects**

THE EUROPEAN UNION AGENCY FOR THE COOPERATION OF ENERGY  
REGULATORS,

Having regard to Regulation (EU) 2019/942 of the European Parliament and of the Council of 5 June 2019 establishing a European Union Agency for the Cooperation of Energy Regulators<sup>1</sup>, and, in particular, Article 11 thereof,

Having regard to Regulation (EU) 2022/869 of the European Parliament and of the Council of 30 May 2022 on guidelines for trans-European energy infrastructure<sup>2</sup> and, in particular, Article 11 thereof,

Having regard to the favourable opinion of the Board of Regulators of 20 September 2023, delivered pursuant to Article 22(5) of Regulation (EU) 2019/942,

Whereas:

**1. INTRODUCTION AND PROCEDURE**

- (1) Pursuant to Article 11(2) of Regulation (EU) 2022/869 ('TEN-E Regulation') by 24 April 2023 the European Network of Transmission System Operators for Gas ('ENTSOG') shall publish and submit to Member States, the Commission and ACER a consistent single sector draft cost-benefit analysis methodology for hydrogen infrastructure projects ('draft CBA methodology') after having gathered input from the relevant stakeholders during the consultation process.

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<sup>1</sup> OJ L158, 14.6.2019, p. 22.

<sup>2</sup> OJ L 152, 3.6.2022, p. 45–102

- (2) Prior to submitting its draft CBA methodology, ENTSOG shall publish a preliminary draft methodology<sup>3</sup> and conduct an extensive and transparent consultation process and seek recommendations from Member States and, at least, the organisations representing all relevant stakeholders as defined in Article 11(2) of the TEN-E Regulation. Stakeholders may submit a recommendation to ENTSOG within three months of publication of the preliminary CBA methodology. The European Scientific Advisory Board on Climate Change ('ESABCC') may, on its own initiative, submit an opinion to the draft methodology. ENTSOG shall provide reasons where they have not, or have only partly, taken into account the recommendations during the consultation process.
- (3) Pursuant to Article 11(3) of the TEN-E Regulation, within three months of receipt of the draft methodology together with the input received in the consultation process and the report on the consultation, ACER shall provide an opinion on the draft CBA methodology. The ACER opinion shall be addressed to ENTSOG, be published, and notified to the Member States and the Commission.
- (4) Pursuant to Article 11(4) of the TEN-E Regulation, within three months of receipt of the draft methodology, Member States may deliver their opinions to ENTSOG and the Commission.
- (5) Pursuant to Article 11(5), within three months of receipt of the opinions of ACER and Member States, ENTSOG shall amend its methodology to fully take into account the opinions of ACER and Member States and submit the amended methodology together with the opinion of ACER to the Commission for approval.
- (6) On 30 June 2023, ENTSOG submitted to ACER for its Opinion a document named "Draft hydrogen cost-benefit analysis methodology"<sup>4</sup>, together with the report on the public consultation of the preliminary methodology<sup>5</sup>.

## **2. SUMMARY OF ENTSOG'S DRAFT CBA METHODOLOGY**

- (7) According to the TEN-E Regulation, ENTSOG has the task to develop a draft CBA methodology with a focus on hydrogen infrastructure for its use in the European-wide ten-year network development plan ('TYNDP'), in the selection process of projects to be included in the Union list<sup>6</sup>, and Cross-Border Cost Allocation ('CBCA') procedures.

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<sup>3</sup> Published on 28 February 2023. [https://entsog.eu/sites/default/files/2023-03/Preliminary%20Draft%20CBA%20Methodology%20for%20Public%20Consultation\\_update.pdf](https://entsog.eu/sites/default/files/2023-03/Preliminary%20Draft%20CBA%20Methodology%20for%20Public%20Consultation_update.pdf)

<sup>4</sup> [https://www.entsog.eu/sites/default/files/2023-06/Draft%20ENTSOG%20CBA%20Methodology\\_June%202023.pdf](https://www.entsog.eu/sites/default/files/2023-06/Draft%20ENTSOG%20CBA%20Methodology_June%202023.pdf)

<sup>5</sup> [https://www.entsog.eu/sites/default/files/2023-06/Consultation%20report%20accompanying%20ENTSOG%27s%20draft%20CBA%20methodology\\_Final.pdf](https://www.entsog.eu/sites/default/files/2023-06/Consultation%20report%20accompanying%20ENTSOG%27s%20draft%20CBA%20methodology_Final.pdf)

<sup>6</sup> Composed by Projects of Common Interest and Projects of Mutual Interest.

- (8) ENTSOG draft CBA methodology for hydrogen infrastructure projects has been prepared following a period of consultation with stakeholders. The main objective of the CBA methodology is to provide a common and uniform basis for the assessment of infrastructure projects.
- (9) The draft CBA methodology is structured along the following chapters: assessment framework, system assessment, project-specific assessment based on an incremental approach. It will be complemented by dedicated input data specifications for each TYNDP cycle ('Implementation Guidelines') that interpret the rules defined in the CBA methodology. Additionally, the scenario report will specify details for scenarios that are not covered by the CBA methodology.
- (10) The draft CBA methodology concerns the hydrogen infrastructure categories described in the paragraph below and set out in Annex II (3) to the TEN-E Regulation and it shall be drawn up in line with the principles laid down in Annex V, be based on common assumptions allowing for project comparison, and be consistent with the Union's energy and climate neutrality objectives, as well as with the rules and indicators set out in Annex IV.

*“(a) pipelines for the transport, mainly at high pressure, of hydrogen, including repurposed natural gas infrastructure, giving access to multiple network users on a transparent and non-discriminatory basis;  
(b) storage facilities connected to the high-pressure hydrogen pipelines referred to in point (a);  
(c) reception, storage and regasification or decompression facilities for liquefied hydrogen or hydrogen embedded in other chemical substances with the objective of injecting the hydrogen, where applicable, into the grid;  
(d) any equipment or installation essential for the hydrogen system to operate safely, securely and efficiently or to enable bi-directional capacity, including compressor stations;  
(e) any equipment or installation allowing for hydrogen or hydrogen-derived fuels use in the transport sector within the TEN-T core network identified in accordance with Chapter III of Regulation (EU) No 1315/2013 of the European Parliament and of the Council. Any of the assets listed in points (a) to (d) may be newly constructed or repurposed from natural gas to hydrogen, or a combination of the two.”*

### **3. ASSESSMENT AND COMMENTS**

#### **3.1. Scope of this Opinion**

- (11) ACER evaluated ENTSOG's submission of the draft CBA methodology. This Opinion covers:
  - a. The development and consultation process (Section 3.2 of this Opinion);
  - b. The changes from the ENTSOG preliminary CBA and following ACER informal feedback (Section 3.3 of this Opinion);

- c. The compliance of the draft CBA methodology with the ACER Position Paper “towards greater consistency of CBA methodologies”<sup>7</sup> (‘position paper on CBA consistency’), published by ACER in March 2023, pursuant to Article 11(8) of the TEN-E Regulation (Section 3.43.3 of this Opinion);
- d. The content of the draft CBA methodology (Section 3.53.3 of this Opinion); and
- e. Key recommendations for improving the CBA methodology.

### 3.2. Development and consultation process

- (12) On 28 February 2023, ENTSOG published its Preliminary draft CBA Methodology for hydrogen projects<sup>8</sup> for public consultation until 31 May 2023. The online public consultation launched by ENTSOG included a total of 47 questions covering different sections of the preliminary draft CBA Methodology<sup>9</sup>.
- (13) On 27 March 2023, ENTSOG held a hybrid public workshop to present its preliminary draft CBA methodology and to collect recommendations and feedback for improvements<sup>10</sup>. More than 50 persons took part in the workshop, and the recording and presentations were published<sup>11</sup>.
- (14) ENTSOG received only 5 replies to its online public consultation, and no recommendations were received from Member States. The European Scientific Advisory Board on Climate Change (‘ESABCC’) issued an opinion<sup>12</sup> mainly focusing on the ENTSO-E CBA methodology as well as on cross-sectorial aspects<sup>13</sup>. ENTSOG prepared a consultation report with justification on how the recommendations received during the consultation process were considered.
- (15) ACER finds that ENTSOG transparently collected feedback from stakeholders via the workshop and the online public consultation workshop based on a published preliminary CBA methodology. However, the number of responses received was quite limited. ACER calls on ENTSOG to consider how to increase the level of

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<sup>7</sup> [https://www.acer.europa.eu/Position%20Papers/ACER\\_Consistency%20of%20CBA%20methodologies.pdf](https://www.acer.europa.eu/Position%20Papers/ACER_Consistency%20of%20CBA%20methodologies.pdf)

<sup>8</sup> [https://entsog.eu/sites/default/files/2023-03/Preliminary%20Draft%20CBA%20Methodology%20for%20Public%20Consultation\\_update.pdf](https://entsog.eu/sites/default/files/2023-03/Preliminary%20Draft%20CBA%20Methodology%20for%20Public%20Consultation_update.pdf)

<sup>9</sup> <https://entsog.eu/sites/default/files/2023-02/Introduction%20for%20Public%20consultation%20Questionnaire.pdf> and <https://forms.office.com/Pages/ResponsePage.aspx?id=YQFgflpN0GmocDjMoCxXHN4pyFtiFFibAoeq8vfKJUMFpLSUo0V1VKWDJDVkpSU0pXVIU1Q0pKNy4u>

<sup>10</sup> <https://www.entsog.eu/entsog-public-workshop-preliminary-draft-cost-benefit-analysis-methodology>

<sup>11</sup> <https://www.entsog.eu/sites/default/files/2023-03/CBA%20Workshop%20Compilation.pptx>

<sup>12</sup> <https://climate-advisory-board.europa.eu/reports-and-publications/towards-a-decarbonised-and-climate-resilient-eu-energy-infrastructure-recommendations-on-an-energy-system-wide-cost-benefit-analysis/advice-on-a-harmonised-eu.pdf/@@display-file/file>

<sup>13</sup> At p.2 of its recommendations document, the ESABCC states that ENTSOG’s “preliminary draft single-sector Cost-Benefit Analysis methodology could not be specifically considered as it was only published on 28 February”.

engagement in future consultations on the CBA methodology to ensure at least the involvement of the organisations mentioned under Article 11(2) of the TEN-E Regulation<sup>14</sup>, for example by addressing individual stakeholders during the consultation process and by planning well in advance their involvement, and on stakeholders to participate in ENTSOG's consultation processes.

- (16) ACER notes that ENTSOG should have published its preliminary methodology much earlier (by end 2022) in order to allow the 3-months public consultation and the submission to ACER by the TEN-E Regulation deadline of 24 April 2023. This would have avoided a delay of 2-months in the submission of the draft methodology. ACER calls on ENTSOG, once again, to plan timely its activities to comply with legal deadlines as well as assure a better stakeholder outreach.

### **3.3. ACER informal feedback on the preliminary CBA methodology**

- (17) ACER appreciates ENTSOG's openness to discuss with ACER and the Commission the findings of ACER's consultancy's study<sup>15</sup> on hydrogen networks CBA and ACER's informal recommendations to improve the preliminary CBA methodology. ACER welcomes that the submitted draft CBA methodology already includes the following changes in comparison to the preliminary CBA methodology:
- a. The addition of "Implementation Guidelines and other complementary documents" as recommended in the ACER position paper on CBA consistency;
  - b. The redrafting and skimming of the Scenarios section to keep it concise and aligned with the joint ENTSOs' scenarios report/methodology and ACER scenario framework guidelines, as well as including the assessment of projects under all ENTSOs' scenarios and for all relevant time horizons;
  - c. More clarity in the description of the dual assessment between gas-hydrogen and the dual assessment between electricity-hydrogen;
  - d. Better description of network modelling in general and on the calculation and use of indicators;

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<sup>14</sup> Seeking individual feedback of organisations representing all relevant stakeholders, such as associations involved in electricity, gas and hydrogen markets, heating and cooling, carbon capture and storage and carbon capture and utilisation, organisations involved in energy efficiency solutions, energy consumer associations, civil society representatives.

<sup>15</sup> ACER contracted a preparatory consultancy study on hydrogen networks which covers possible recommendations for ENTSOG's cost-benefit analysis methodology (CBA) for hydrogen infrastructures. The consultancy study and the related webinar recording are available at:

[https://www.acer.europa.eu/Publications/Study\\_on\\_ENTSOG\\_CBA\\_for\\_hydrogen\\_infrastructure\\_ACER.pdf](https://www.acer.europa.eu/Publications/Study_on_ENTSOG_CBA_for_hydrogen_infrastructure_ACER.pdf)  
and <https://www.acer.europa.eu/public-events/acer-webinar-consultancy-study-hydrogen-networks>

- e. The distinction between “cross-border” and “internal”<sup>16</sup> projects;
- f. The definition of the year from which on the project benefits will start counting, which is defined as the year after the project commissioning year<sup>17</sup>;
- g. A different definition of hydrogen and natural gas reference networks;
- h. The adaptation of grouping principles, type of project benefits, their definition and calculation of indicators.

### **3.4. Consistency of ENTSOG’s draft CBA methodology with ACER position paper “Towards greater consistency of cost benefit analysis methodologies”**

- (18) The TEN-E Regulation stresses the importance of consistency in the single sector cost-benefit analysis methodologies which are to be developed according to Article 11 of the TEN-E Regulation.
- (19) Article 11(8) of the TEN-E Regulation assigned ACER the task to promote the consistency of the methodologies developed by the European Commission with the methodologies elaborated by ENTSO-E and ENTSOG. On 22 March 2023, ACER published its position paper to support that a greater consistency is achieved across all CBA methodologies.
- (20) ACER acknowledges that ENTSOG has taken into account ACER’s position paper on CBA consistency in its draft methodology. However, ACER finds that there is room to further increase the consistency between the draft CBA methodology on hydrogen infrastructures and the electricity CBA methodology and other CBA methodologies published by the European Commission in May 2023<sup>18</sup>.

### **3.5. The content of the draft CBA Methodology**

#### **3.5.1. TEN-E requirements (Chapter 1 of ENTSOG’s CBA methodology)**

- (21) ACER appreciates that the draft CBA methodology includes a table indicating its compliance with the TEN-E Regulation requirements. However, this table does not provide sufficient explanation nor evidence on how the requirements are actually met. ACER recommends ENTSOG to further elaborate on the compliance of the

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<sup>16</sup> I.e., according to ENTOG’s methodology, any meaningful transmission constraints within one country or area.

<sup>17</sup> Even though in the draft CBA methodology such rule seems applied only to the Economic Performance Indicators while, in ACER’s view, it should be applied to all assessed benefits.

<sup>18</sup> Which cover hydrogen infrastructure projects, cross-border carbon dioxide network projects, energy storage projects, electrolyser projects, smart gas and smart electricity grid projects)

[https://energy.ec.europa.eu/consultations/targeted-consultation-methodologies-assessing-costs-and-benefits-candidate-projects-under-revised\\_en](https://energy.ec.europa.eu/consultations/targeted-consultation-methodologies-assessing-costs-and-benefits-candidate-projects-under-revised_en)



CBA methodology with the legal requirements in the adapted CBA methodology by providing clear explanations on how the different requirements are met.

- (22) Furthermore, in line with Article 11(6) of the TEN-E Regulation, ACER recommends that the ENTSOG CBA Methodology includes a list of (minimum) input data and output data to be published with its application in each TYNDP.

3.5.2. CBA Implementation Guidelines (Chapter 2 of ENTSOG’s CBA methodology)

- (23) ACER welcomes that the draft CBA methodology includes a section on “Implementation Guidelines (‘IGs’) and other complementary documents”. As recommended in the ACER position paper on CBA consistency, ENTSOG CBA methodology should also specify that the elements included in the IGs, as well as in any other complementary document (e.g. the TYNDP project Practical Implement Document - PID), have to be consulted with all relevant stakeholders, including ACER and the Commission, before every TYNDP.

- (24) While acknowledging the need for flexibility and for a gradual implementation of certain aspects of the CBA methodology, ACER reiterates that the CBA methodology should define, to the extent possible, all rules and principles to be applied<sup>19</sup>, while the IGs should focus on the details, the parameters, or the specific assumptions which may vary in each TYNDP.

- (25) In ACER’s view, in addition to the elements proposed in the draft CBA methodology, the IGs (or in some cases the PID) should include at least:

- a. Relevant assumptions used for market, network and redispatch modelling;
- b. A clear description of the tools used and of the different roles in performing the modelling (especially if jointly performed by ENTSOG and ENTSO-E);
- c. All definitions and criteria used to define cross-border and internal infrastructures;
- d. All definitions for the different types of capacities considered (e.g. yearly firm capacity, peak capacities, etc.);
- e. A description of the criteria used for the definition of the natural gas and hydrogen grids;

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<sup>19</sup> For example, at p.9 of the draft CBA Methodology ENTSOG states “[...] *For subsequent TYNDPs, a validation mechanism **might** be established.*”, while at p.16 ENTSOG states “[...] *consistency check phase in the data collection **may** be conducted by ENTSOG to ensure as reliable information as possible*”. In ACER’s view such formulations leave these tasks as a mere possibility, while they should be established in the methodology.

- f. The list of TYNDP projects and related capacities included in the natural gas and hydrogen grids;
- g. The identification and treatment of competing and interdependent projects;
- h. The approach and values of the cost of disruption of gas supply ('CODG') and the cost of disruption of hydrogen supply ('CODH');
- i. The list of non-CO2 emission types and related emission factors;
- j. The societal cost of carbon and other emissions.
- k. The definition of the project costs considered and the unit investment costs reference used (if any).

3.5.3. CBA Scenarios (Chapter 2.1 of ENTSOG's draft CBA methodology)

- (26) ACER welcomes that the draft CBA methodology includes a table listing the elements from scenarios which are relevant for the application of the CBA. ACER recommends ENTSOG to further review, also in coordination with ENTSO-E, the elements described in the Table 3 of the draft CBA methodology and to make sure that all relevant information is included<sup>20</sup>.

3.5.4. CBA Network and Market modelling assumptions (Chapter 2.2 of ENTSOG's draft CBA methodology)

3.5.4.1. *Dual assessments gas-hydrogen and electricity-hydrogen*

- (27) The draft CBA methodology introduces a new concept of dual assessment between gas-hydrogen and a dual assessment between electricity-hydrogen aiming to capture interactions between the different sectors. However, ACER finds the descriptions provided in the CBA methodology to be still insufficient for a comprehensive understanding and replicability.
- (28) ACER finds that more clarity is still needed on the way network modelling, market modelling and dual assessments should be performed and recommend ENTSOG to include all relevant information in the final CBA methodology, including examples and the necessary detailed steps to perform the assessment.
- (29) ACER finds that common rules should apply for defining the electricity, hydrogen and natural gas reference grids used in the joint modelling simulations.

3.5.4.2. *Distinction of cross-border and internal infrastructures*

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<sup>20</sup> For example, the supply prices and the supply CO2 contents are currently missing from Table 3.



- (30) ACER welcomes that the draft CBA methodology includes the concept of “*meaningful transmission constraints within one country*”. However, it is not clear how ENTSOG will assess the European relevance of such infrastructures. ACER calls on ENTSOG to develop further guidelines on how to collect, distinguish and consult on “cross-border” and “internal” infrastructures.

3.5.4.3. *Criteria for assessing the plausibility of projects’ commissioning year*

- (31) The draft CBA methodology should include criteria to assess plausibility of project’s commissioning year, as per ACER position paper on CBA consistency. ENTSOG states that for TYNDP 2024 project promoters should provide justification for the expected commissioning year and that for the subsequent TYNDPs a validation mechanism might be established by ENTSOG. ACER finds ENTSOG’s approach reasonable, but it calls to explicitly include in the CBA methodology the criteria to evaluate the accuracy of the information provided by project promoters and the measures to be adopted by ENTSOG in case such accuracy is missing (e.g. ranges of commissioning years).

3.5.4.4. *Hydrogen reference network(s)*

- (32) ACER welcomes that the draft CBA methodology includes a proposal of hydrogen networks which is more balanced<sup>21</sup> between a “conservative” and a more “optimistic” view of the future evolution of the hydrogen grid. Notwithstanding this, ACER recommends to:

- Include an existing infrastructure level that contains only existing infrastructures and all infrastructures expected to be commissioned no later than 31<sup>st</sup> December of the year of TYNDP. This infrastructure level could be used as minimum reference network when hydrogen infrastructures have reached a certain level of development<sup>22</sup>.
- The conditions for a project to be considered as an “advanced project” are already defined in the CBA methodology as the projects included in the last national development plan (‘NDP’) and/or having concluded a market test and/or having reached the final investment decision (‘FID’). During ACER’s webinar on its consultancy study on hydrogen networks, nearly

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<sup>21</sup> The draft CBA methodology proposes the following infrastructure levels:

1. FID hydrogen infrastructure level: Existing infrastructure+ FID (not for TYNDP 2024)
2. “Advanced hydrogen infrastructure level: As FID level + advanced infrastructure (PID and IG to define “advanced”, possibly based on inclusion in NDP or result of market test.
3. PCI hydrogen infrastructure level: As advanced level + remaining PCIs
4. TYNDP infrastructure level: As PCI level + all remaining TYNDP projects

<sup>22</sup> ACER acknowledges that today only few kilometres of hydrogen infrastructures exist besides a few existing hydrogen pipelines operated by companies for mainly feedstock purposes in chemical industries.

60% respondents supported the use of an “advanced infrastructure level” as reference network based on the criteria described above<sup>23</sup>.

- The TYNDP hydrogen infrastructure level, consisting of the PCI hydrogen infrastructure level as well as all remaining projects submitted to the TYNDP is deemed overly optimistic. Thus, ACER recommends to remove the TYNDP hydrogen infrastructure level from the assessment.
- The CBA methodology should clearly state that the lesser-of-rule<sup>24</sup> (LoR) should be consistently applied when building all infrastructure levels, to both natural gas projects and hydrogen projects. The LoR should be applied also to projects where the resulting capacity after its application is zero.

- (33) Over time, ACER strongly recommends that the rules applied by ENTSOG and ENTSO-E to plan/build the natural gas, hydrogen and electricity reference networks become as consistent as possible, also across the different steps of TYNDP (i.e. also extending to scenarios reference grids). This would require greater effort to align the concepts and consistently merge them into a single concept.

#### 3.5.4.5. *Natural gas reference network(s)*

- (34) ACER finds that the draft CBA methodology clarifies that the transmission system operators (‘TSOs’) must continue to submit natural gas projects to TYNDP for keeping the natural gas reference network updated.
- (35) Since project promoters are not legally obliged to submit their projects to TYNDP and an updated topology is of utmost importance for a proper infrastructure assessment, ACER invites ENTSOG to explore, in the PID, alternative ways to ensure that all relevant information on natural gas projects are reflected in the TYNDP topology even when not submitted by project promoters.
- (36) ENTSOG should also clarify what the following sentence at p.63 means: “*Only cost related to hydrogen infrastructure should be considered, while it shall be transparently displayed which additional costs might be required (e.g., in the natural gas system) to enable the hydrogen infrastructure by linking it to natural gas projects [...]*”. ACER reiterates the importance of having full transparency on the project costs collected and used in the assessment<sup>25</sup>.

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<sup>23</sup> [VIS consultancy study for ACER on requirements and implementation of ENTSOG’s Cost Benefit Analysis for hydrogen infrastructure , p.183](#)

<sup>24</sup> According to TYNDP 2022 Infrastructure Report, “*The “lesser-of-rule” means that, on a Point with Entry and Exit capacities, the minimum of the two values will be considered as the firm capacity available for use.*”.

<sup>25</sup> Considering the example included in the draft CBA methodology, in the case of additional investments in natural gas infrastructures triggered by security of supply needs after the repurposing of natural gas infrastructures to hydrogen, the costs of these additional investments should be transparently displayed and included in the economic performance indicator of the project group assessment (or, in alternative, the cost of the curtailed gas

### 3.5.5. CBA System Assessment: Identification of infrastructure gaps (Chapter 3 of ENTSOG's CBA methodology)

#### 3.5.5.1. *Infrastructure gaps*

- (37) Under the TEN-E Regulation, the infrastructure gap identification becomes a stand-alone deliverable in the TYNDP framework, being subject to ACER's and Commission's opinions<sup>26</sup>. The approach currently proposed in the draft CBA methodology for hydrogen infrastructure gaps identification is very similar to the one followed for natural gas in previous TYNDPs. However, applying the same approach misses the fact that, except for dedicated industrial (cross-border) pipelines for feedstock purposes in a few countries, currently there is no hydrogen infrastructure in Europe.
- (38) ACER welcomes that the draft CBA methodology (p.31) plans to further increase the consistency along the entire TYNDP exercise by planning to include “[...] a comparison between the infrastructure levels and the topology derived from the expansion model within the scenario process may be provided, analysing where submitted projects result in less [or more] capacity than in the expanded grid.”. However, ACER emphasises that the effectiveness and quality of such comparison also depends on the level and the quality of the infrastructure's assumptions in the scenario model<sup>27</sup>.
- (39) ACER encourages ENTSOG to commit to identify the increases in capacities needed to meet hydrogen demand and supply levels, following an approach which ensures consistency and interlinkages with the scenarios process and with the electricity TYNDP. This commitment should be enshrined in the CBA methodology as a goal and consistently improved over the years, rather than left as a mere possibility.
- (40) Similarly to ENTSO-E's approach in the System Needs Study<sup>28</sup>, the infrastructure gap analysis should focus on identifying and quantifying future needs in terms of hydrogen cross-border capacities (as well as import capacities) to be developed. Ideally, the infrastructure gaps analysis should be consistently carried out by ENTSOG and ENTSO-E as a separate exercise from CBA, with its own

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demand without the construction of the additional natural gas infrastructure should be considered as project impact).

<sup>26</sup> According to Article 11 and Article 13 of Regulation (EU) 2022/689 and Article 8(10) of Regulation 715/2009, the CBA methodology sets also the frame for the infrastructure gap report.

<sup>27</sup> On 4 July 2023, ENTSO-E and ENTSOG published their TYNDP 2024 Scenarios Storyline Report for public consultation. In the dataset published along with the storylines, ENTSOG and ENTSO-E assume as hydrogen reference grid in 2030 (i.e. the starting point for the scenarios expansion model) all the capacities included in the TYNDP 2022 hydrogen “Infrastructure Level 1”, which is almost entirely composed by less-advanced projects which capacities are, in many cases, not matched by all involved project promoters. This represents a too optimistic view of the hydrogen infrastructure development.

<sup>28</sup> <https://eepublicdownloads.blob.core.windows.net/public-cdn-container/tyndp-documents/TYNDP2022/public/system-needs-report.pdf>

methodology to be consulted well in advance of the gaps assessment. ACER also recommends ENTSOE to further liaise with ENTSO-E on how to address this recommendation in the best way possible.

#### 3.5.5.2. *Natural gas needs assessment*

- (41) The proposed draft CBA methodology introduces the concept of dual assessment between gas-hydrogen. However, natural gas aspects are only included in the methodology to the extent they are needed to assess hydrogen infrastructures. The draft CBA methodology does not clarify which indicators should be used in TYNDPs for the assessment of natural gas infrastructure needs alone. ACER recommends ENTSOE to clarify in the CBA methodology which indicators should be used to assess natural gas infrastructure needs.

#### 3.5.6. CBA Project-Specific Assessment: grouping (Chapter 4 of ENTSOE's CBA methodology)

##### 3.5.6.1. *Project grouping principles*

- (42) ACER notes that the draft CBA methodology clustering (or grouping) rules have been revised following ACER informal feedback on the preliminary methodology. However, ENTSOE's clustering rules are not fully consistent yet with the clustering rules proposed by ACER in its position paper on CBA consistency and with the rules proposed by ENTSO-E in its 4<sup>th</sup> CBA Guideline.
- (43) ACER calls on ENTSOE to adapt the draft CBA methodology clustering rules in order to fully align them with ACER's position paper on CBA consistency and with ENTSO-E's approach. In particular, the following clustering rules should be respected:
- a. Enabler projects must be maximum one stage of maturity apart from the enabled project, instead of two stages of maturity<sup>29</sup>;
  - b. Enabler projects "under consideration" can only be grouped with enabled projects of the same stage of maturity<sup>30</sup>;
  - c. Enabled projects' commissioning year can only be equal or later than the enabler(s)' one<sup>31</sup>; and
  - d. For all clustered projects, the commissioning of projects should be up to 5 years apart, instead of 10 years apart as proposed by ENTSOE. As ENTSOE draft CBA methodology states (p.35) "*Grouping together projects expected to be*

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<sup>29</sup> This rule should also be applied at Infrastructure Levels stage and not only in the PS-CBA grouping phase.

<sup>30</sup> This rule should also be applied at Infrastructure Levels stage and not only in the PS-CBA grouping phase.

<sup>31</sup> This rule should also be applied at Infrastructure Levels stage and not only in the PS-CBA grouping phase.

*commissioned far apart in time may introduce the risk that eventually one or more investments are not realised”.*

The above rules should be considered as default rules.

- (44) In addition, ACER recommends ENTSOG to include a high-level description of the clustering process in the CBA methodology in order to define the steps to be followed for project clustering, and the stakeholder roles. As proposed in the CBA methodology, the clustering rules should be reassessed, and consulted, in the IGs for each TYNDP.
- (45) In the short-term (for the upcoming TYNDP 2024), the clustering rules defined in the CBA methodology may be used in a more flexible way in case they will impede a logical grouping of projects, absent an existing hydrogen network. In the mid-term (beyond TYNDP 2024), as hydrogen projects are expected to develop, ENTSOG rules should become closely aligned with the ENTSO-E ones.

#### 3.5.6.2. *Identification of competing projects*

- (46) The draft CBA methodology does not define clear rules on how to pre-identify “competing projects” and it only states that “*The competition between projects might be an observation from the intermediate PS-CBA results.*”. This could be resolved by identifying hydrogen target capacities in the gaps identification. In cases where two projects have submitted capacities higher than the target capacities, these projects would be identified as competing.

#### 3.5.7. CBA Project-Specific Assessment: indicators and benefits (Chapters 4.1, 4.2 and 4.3 of ENTSOG’s CBA methodology)

- (47) ENTSOG draft CBA methodology states that “*The details on how the indicators are calculated should be part of the TYNDP report in form of an Annex, as well as part of the Implementation Guidelines of the corresponding TYNDP and PS-CBA process [...]*”<sup>32</sup>. ACER reiterates the importance for consulting on the indicators well in advance of the TYNDP gaps and project assessment start. To enable a broad participation of all relevant stakeholders, ACER invites ENTSOG to publish the TYNDP project plan beforehand and to communicate with all relevant stakeholder the planned timeline for consulting, as part of each TYNDP cycle, on the indicators and on any other assumption included in the IGs.
- (48) For each indicator table, ENTSOG should specify to which project category applies. In addition, in line with Annex V(7) of the TEN-E Regulation, ENTSOG should

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<sup>32</sup> With the inclusion of IGs as part of the TYNDP, there is no need for a specific Annex since all CBA elements (including the indicators) would be part of the IGs, subject to consultation and published in the final version of the IGs before the TYNDP assessment starts.

specify which indicator should be computed at country level, allowing to identify all countries on which the project has “net positive impact” and “net negative impact”.

- (49) In ACER’s view the current draft CBA methodology does not fully capture the following benefits described in the TEN-E Regulation:
- a. Contribution of a project to flexibility and seasonal storage options for renewable electricity generation (Annex IV(5)(a));
  - b. The contribution of a project to the integration of market areas and to price convergence (Annex IV(5)(b));
  - c. The contribution of a project to supply diversification and facilitation of access to indigenous sources of hydrogen supply (Annex IV(5)(d));
- (50) ACER invites ENTSOG to consider the recommendations below and to further explore how to incorporate a set of indicators which would allow to capture the full scope of benefits envisaged in the TEN-E Regulation, also by consulting all relevant stakeholders. To identify improvements for the CBA indicators, ACER also recommends ENTSOG to exchange with experts in infrastructure assessment and modelling (e.g. through dedicated workshops or prime movers group).

*3.5.7.1. Indicator B1 - Societal benefit due to GHG emissions variation*

- (51) ACER welcomes that, compared to the preliminary draft methodology, the scope of indicator B1 has been extended also to non-CO2 emissions and to non-power sectors. However, ACER finds the description of the methodology for calculating indicator B1 still partially unclear, in particular concerning the calculation of GHG emissions savings from replacement of alternative fuels in non-power sectors. Therefore, ACER invites ENTSOG to provide additional clarifications regarding the specific steps to be followed for indicator B1 as well as regarding the input needed.

*3.5.7.2. Indicator B2 - Social Economic Welfare for hydrogen sector*

- (52) ACER understands that the proposed indicator B2 does not entirely cover the situations where hydrogen would replace the use of other fuels (e.g. by replacing oil in transport). As an indicator measuring competition and market integration, ACER recommends that the indicator B2 includes fuel substitution aspects as part of the socio-economic welfare (‘SEW’) calculation. This should also allow to identify situations where hydrogen will replace cheaper (as hydrogen could be more expensive) but more polluting fossil fuels (with this second part of benefit that would be captured under indicator B1).

*3.5.7.3. Indicator B3 - Renewable Energy integration*

- (53) ACER understands that the indicator B3 only focuses on benefits from reducing the amount of curtailed renewable generation or benefits from increasing the amount of renewable generation that is connected by the project. ACER recommends



expanding the scope of indicator B3 to capture projects contribution to the integration of low-carbon hydrogen, as indicated by Annex IV(5)(a).

*3.5.7.4. Indicator B4 - Societal benefit due to non-GHG emissions variation*

- (54) ACER welcomes that the draft CBA methodology clearly states that non-GHG emissions related benefits should not justify alone the construction (or non-construction) of hydrogen infrastructure projects.
- (55) ACER understands that the calculation of the indicator B4 is based on an ex-post allocation of the non-GHG emission savings derived from TYNDP scenarios data. However, the draft methodology does not explain the allocation key that should be used in distributing the emissions reductions (e.g. based on the flows resulting from the modelling). ACER invites ENTSOG to provide further clarity in the CBA methodology on the allocation key(s) used. The proposed approach should also be reassessed and consulted as part of each TYNDP cycle.

*3.5.7.5. Indicator B5 - Reduction in exposure to curtailed demand*

- (56) ENTSOG draft CBA methodology at p.41 explains that the indicator B5 covers both security of supply and market integration criterion. However, the indicator B5 measures the reduction on curtailed demand under certain stressful situations. As such, this indicator should be considered as “security of supply” indicator only.
- (57) ENTSOG should further clarify in the methodology how hydrogen demand in clusters (presumably not connected to the grid at least at the beginning of hydrogen demand uptake) should be considered when computing indicator B5.
- (58) ENTSOG should also provide additional clarification on whether the impact of future extreme weather events on infrastructure resilience is included in B5<sup>33</sup> (or in any other indicator) and, if so, how it is considered.
- (59) ENTSOG draft CBA methodology proposes to use the value of the cost of disruption of gas (‘CODG’) as a proxy for the cost of disruption of hydrogen (‘CODH’). As current gas consumers are expected to be different from hydrogen consumers, the CBA methodology should recommend the use of dedicated CODH values for the hydrogen infrastructures assessment. Those CODH values could be based on the analysis of industrial demand. The proposed methodology and both CODH and CODG values should be reassessed and consulted as part of each TYNDP cycle.

*3.5.7.6. Indicator B6 - Cross-border impact of hydrogen transmission projects*

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<sup>33</sup> Theoretically, the assessment of the impact of future extreme weather events on infrastructure resilience could be split into two aspects: the impact on demand and supply (likely addressed in the joint TYNDP scenarios) and the impact on the actual availability of infrastructures (to be addressed in the infrastructures assessment).



- (60) An increase of cross-border capacity does not automatically translate in more diversified access to supply sources. ENTSOG should clarify (and amend if needed) how the indicator B6 allows to measure the contribution of projects to supply diversification and to access to indigenous sources of hydrogen supply.

*3.5.7.7. Concerning Environmental Impact indicator*

- (61) ACER recommends that all information concerning projects' environmental impact is mandatory and collected from project promoters directly during the TYNDP project collection (and published as part of TYNDP Annex A and PS-CBA project fiches).
- (62) ACER welcomes that the draft CBA methodology states that any additional expected cost connected to environmental mitigation measures should be included in the economic performance indicators. However, ACER strongly disagrees with the sentence “*If such costs are not included in the economic performance indicators used for other TEN-E infrastructure categories like electricity, they shall also not be considered for hydrogen infrastructure projects when comparing these infrastructure projects.*” and recommends ENTSOG to remove this text from the CBA methodology and to ensure that such costs are always considered as part of the economic performance indicators calculation<sup>34</sup>.
- (63) Concerning this indicator, the CBA methodology should describe the methodological framework for the assessment of those impacts and specify the unit measures for the data. Also, it should seek as much consistency as possible with ENTSO-E's approach<sup>35</sup>.

*3.5.7.8. Project Costs indicator (chapter 4.5)*

- (64) ACER recommends ENTSOG to publish cost information as foreseen in ENTSO-E 4<sup>th</sup> CBA Guidelines (pp.91-95).

3.5.8. CBA Economic Parameters and Performance Indicators (Chapter 4.6 of ENTSOG's CBA methodology)

*3.5.8.1. Societal discount rate, SDR*

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<sup>34</sup> This recommendation is also aligned with ACER recommendation to ENTSO-E indicators S1-S3 included in ACER Opinion to ENTSO-E draft 4<sup>th</sup> CBA methodology (p.15) available here [https://www.acer.europa.eu/Official\\_documents/Acts\\_of\\_the\\_Agency/Opinions/Opinions/ACER\\_Opinion\\_07-2023\\_on\\_the\\_draft\\_4th\\_ENTSO-E\\_Guideline\\_for\\_Cost\\_Benefit\\_Analysis.pdf](https://www.acer.europa.eu/Official_documents/Acts_of_the_Agency/Opinions/Opinions/ACER_Opinion_07-2023_on_the_draft_4th_ENTSO-E_Guideline_for_Cost_Benefit_Analysis.pdf).

<sup>35</sup> In line with ACER position paper on CBA consistency, regarding the residual social and environmental impacts of the projects under assessment (currently not captured by monetised benefit indicators), a common methodological framework for the assessment should be described in all CBA methodologies.

- (65) The draft CBA methodology proposes the use of 3% for discounting costs and benefits. This social discount rate ('SDR') value differs from the 4% SDR used in the past<sup>36</sup> and which is used by ENTSO-E in its proposed 4th CBA Guideline.
- (66) ACER supports the use of the same SDR in both ENTSOs' methodologies and other CBA methodologies under Article 11 of the TEN-E Regulation. ACER calls on the ENTSOs and the Commission to discuss and agree on the use of a common value for SDR for its use in all CBA methodologies.

*3.5.8.2. Economic lifetime and physical life of a project*

- (67) The draft CBA methodology proposes a 40-year period for the economic assessment of hydrogen infrastructure projects, combined with a sensitivity for 25 years of economic lifetime with residual value.
- (68) ACER recommends that the draft CBA methodology should prescribe an assessment period of 25 years for the following reasons:
- a. The assessment period should not be confused with the technical or economical lifetime of projects, the latter being indeed longer for many infrastructures;
  - b. To cover an assessment period of 40 years, the scenarios should be built up to 2060/2070. Such long-term scenarios would not provide meaningful results, considering the increasing uncertainty as the scenarios' horizon is extended. Even in the absence of long-term scenarios, extending the project benefits, for example, through interpolation would not provide neither meaningful nor credible results. It is preferable to limit the assessment period rather than to consider very uncertain long-term benefits, for which scenarios are not even available;
  - c. A 40-year assessment period goes beyond the timeline of the EC 2050 long-term strategy;
  - d. Annex I to the Commission Delegated Regulation (EU) No. 480/2014 proposed the use of a reference period of 15 – 25 years for CBA analysis;
  - e. During ACER's webinar on a consultancy study on hydrogen networks, more than 60% of respondents supported the use of 25-years for the economic

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<sup>36</sup> The 4% value was based on the "European Commission - Guide to Cost-Benefit Analysis of Investment Projects" (2014), p.55, while most recently the European Commission recommended a 3 % (in real terms) social discount rate for EU policy analysis (as stated in the "Economic Appraisal Vademecum 2021-2027").

assessment for hydrogen projects, in order to consider a timeframe where uncertainty is reasonably acceptable<sup>37</sup>;

- f. For consistency with ENTSO-E's CBA methodology, which uses an assessment period of 25 years, where also electricity projects have a longer technical lifetime; and
  - g. For consistency with all the JRC methodologies used for current PCI selection (including the one for hydrogen projects) which consider an assessment period of 25 years.
- (69) For projects with technical lives shorter than the assessment period, the economic analysis should be performed until the end of their lifetime.

### 3.5.9. CBA Sensitivity Analysis and Residual value (Chapter 4.7 of ENTSOG's CBA methodology)

#### 3.5.9.1. *Sensitivity analyses*

- (70) ACER welcomes that the draft CBA methodology includes a sensitivity on the cost of green-house gases ('GHG') as required per Annex V to the TEN-E Regulation and ACER position paper on CBA consistency. ACER invites the ENTSOs to seek as much consistency as possible in the approach used for the sensitivity analysis.

#### 3.5.9.2. *Residual value*

- (71) ACER considers that no residual value should be included in the CBA methodology in the calculations, consistently with the current ENTSO-E approach. The use of zero residual value in the calculation of the economic performance indicators provides a conservative view of a project's benefits, as it only focuses on the assessment period, and does not consider potential continuation of its impact in a longer-term period, which is uncertain. Additional considerations on the treatment of residual value are provided in an ACER consultancy's study<sup>38</sup>. Thus, ACER recommends ENTSOG to adapt the draft CBA methodology to make sure that no residual value is considered.

### 3.5.10. CBA implementation, presentation and need of examples

- (72) ACER notes that the draft CBA methodology has revised the descriptions provided for some benefits' indicators aiming at providing more clarity on how modelling outputs are used and the indicators are practically calculated.

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<sup>37</sup> [VIS consultancy study for ACER on requirements and implementation of ENTSOG's Cost Benefit Analysis for hydrogen infrastructure](#), p.182.

<sup>38</sup> [VIS consultancy study for ACER on requirements and implementation of ENTSOG's Cost Benefit Analysis for hydrogen infrastructure](#), p.84.

- (73) ENTSOG should include in the adapted CBA methodology or in complementary documents:
- a. A numerical example calculating each benefit for each type of fictional hydrogen infrastructure project (transmission pipelines, storage facilities, LH2 terminals and projects for hydrogen in the transport sector).
  - b. A complete case study presenting the application of the methodology (inputs provided by the promoter, assessment of costs, estimation of benefits, calculation of economic performance indicators, sensitivity analysis) for a fictional hydrogen infrastructure project, similar to the presentation of case studies in the Commission's DG-Regio to Cost-Benefit Analysis of Investment Projects<sup>39</sup>.
- (74) ACER believes that the CBA methodology should be presented in a more practical way. Examples and guidelines on the application of the methodology to specific cases and projects is particularly important to help the users of the methodology to apply it to concrete projects and to help the project evaluators to understand and interpret the results of the CBA assessments.
- (75) In addition, ACER recommends ENTSOG to organise for promoters and other stakeholders open webinars and/or trainings before each cycle of implementation of the CBA methodology to explain how to apply the CBA and interpret the results. These trainings with examples of application of the methodology are particularly important for providing better understanding and consistency in the implementation of the methodology.
- (76) ENTSOG should develop an open toolbox/manual including a template/calculator in which quantitative information and estimates are converted into values to deliver an economic benefits/cost (B/C) ratio of the project.
- (77) ENTSOG should use (online) project fiches to present CBA information about all the projects included in the TYNDP, following ENTSO-E's practice. The structure of the fiches, to be defined in the implementation documents of the CBA methodology, should be as consistent as possible across sectors. The minimum contents of the project fiches should be agreed between the ENTSOs and consulted with the Commission and ACER,

**HAS ADOPTED THIS OPINION:**

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<sup>39</sup> <https://op.europa.eu/en/publication-detail/-/publication/120c6fcc-3841-4596-9256-4fd709c49ae4> and [Inforegio - Economic Appraisal Vademecum 2021-2027 - General Principles and Sector Applications \(europa.eu\)](https://op.europa.eu/en/publication-detail/-/publication/120c6fcc-3841-4596-9256-4fd709c49ae4)

1. ACER has assessed ENTSOG's submitted draft CBA methodology for hydrogen infrastructure projects, which ENTSOG has prepared following a period of consultation with stakeholders. ACER welcomes that the submitted draft CBA methodology includes improvements to the preliminary CBA methodology, following informal exchanges between ACER and ENTSOG.
2. ACER notes that the draft CBA methodology for hydrogen infrastructure projects is, to a large extent, consistent with the rules and indicators of Annex IV, the principles of Annex V and the specific criteria of Article 4(3)(d) to the TEN-E Regulation.
3. ACER calls on ENTSOG to implement the following adaptations to the draft CBA Methodology before it will be submitted to the Commission:
  - a. Review the list of information to be included and consulted as part of the TYNDP Implementation Guidelines and other complementary documents;
  - b. Improve the project planning to allow for a better consultation of stakeholders;
  - c. Modify the definition of the hydrogen reference grid. The conditions for a project to be considered as "advanced project" should be defined in the CBA methodology as the projects included in the last national development plan ('NDP') and/or have concluded a market test and/or have reached the final investment decision (FID), while the TYNDP hydrogen infrastructure level should be removed. Over time, ENTSOG and ENTSO-E rules to build the natural gas, hydrogen and electricity reference networks should become as consistent as possible;
  - d. Provide more clarity on the way the proposed dual assessments are performed;
  - e. Strengthen the project clustering rules and align them with ACER position on CBA consistency as well as with ENTSO-E clustering approach, while allowing some flexibility in the implementation for the next TYNDP 2024, in case those rules impede a logical grouping of projects due hydrogen network maturity;
  - f. ENTSOG to commit to identify, as part of the infrastructure gap exercise, the capacities needed to meet hydrogen demand and supply levels, following an approach which ensures consistency and interlinkages with the scenarios process and with the electricity TYNDP;
  - g. Improve the indicators, notably by providing a clear and detailed description of the calculation steps and formulas to be applied, as well as by ensuring compliance with all the requirements established in Annex IV(5) of the TEN-E Regulation;
  - h. Clarify in the CBA methodology which element and indicator should be used to assess natural gas infrastructure needs for sustainability, security of supply, market integration and competition, and expand their scope if needed;

- i. Use the same social discount rate in all CBA methodologies. ACER calls on ENTSOs and the Commission to discuss and agree on the use of a common value for the social discount rate;
  - j. Prescribe an assessment reference period for all projects of maximum 25 years. For projects with a technical life shorter than the assessment period, the analysis should be performed until the end of their lifetime;
  - k. Not to use the residual value in the project calculations, following a prudent approach to projects benefits calculations;
  - l. Improve the presentation of the CBA methodology, by providing examples of application to fictional hydrogen projects (transmission pipelines, storage facilities, LH2 terminals and projects for hydrogen in the transport sector), developing a CBA toolbox and a CBA template as consistent as possible with ENTSOE's CBA for electricity projects. The CBA fiches should be published for all projects included in the TYNDP, following ENTSO-E's practice.
4. In line with Article 11(5) of the TEN-E Regulation, ENTSOG shall fully take into account this Opinion and submit to the Commission an amended CBA methodology within 3-months. ACER expects ENTSOG to clearly show in its amended CBA methodology how the proposed recommendations have been considered, including reasons in case they would not be followed, in order to facilitate the Commission's assessment when deciding on the approval of the amended CBA methodology.
5. ACER stands ready to constructively work with ENTSOG and the European Commission for improving ENTSOG's CBA methodology.

This Opinion is addressed to ENTSOG.

This Opinion is notified to ENTSO-E, ENTSOG, the Member States and the Commission.

Done at Ljubljana, on 25 September 2023.

**- SIGNED -**

*For the Agency*  
*The Director*  
C. ZINGLERSEN