TYNDP 2022

Stakeholders Engagement Report

Final Version · May 2023

entsoe

ENTSO-E Mission Statement

Who we are

ENTSO-E, the European Network of Transmission System Operators for Electricity, is the **association for the cooperation of the European transmission system operators (TSOs)**. The 39 member TSOs, representing 35 countries, are responsible for the **secure and coordinated operation** of Europe's electricity system, the largest interconnected electrical grid in the world. In addition to its core, historical role in technical cooperation, ENTSO-E is also the common voice of TSOs.

ENTSO-E **brings together the unique expertise of TSOs for the benefit of European citizens** by keeping the lights on, enabling the energy transition, and promoting the completion and optimal functioning of the internal electricity market, including via the fulfilment of the mandates given to ENTSO-E based on EU legislation.

Our mission

ENTSO-E and its members, as the European TSO community, fulfil a common mission: Ensuring the **security of the interconnected power system in all time frames at pan-European level** and the **optimal functioning and development of the European interconnected electricity markets**, while enabling the integration of electricity generated from renewable energy sources and of emerging technologies.

Our vision

ENTSO-E plays a central role in enabling Europe to become the first **climate-neutral continent by 2050** by creating a system that is secure, sustainable and affordable, and that integrates the expected amount of renewable energy, thereby offering an essential contribution to the European Green Deal. This endeavour requires **sector integration** and close cooperation among all actors.

Europe is moving towards a sustainable, digitalised, integrated and electrified energy system with a combination of centralised and distributed resources.

ENTSO-E acts to ensure that this energy system **keeps consumers at its centre** and is operated and developed with **climate objectives** and **social welfare** in mind.

ENTSO-E is committed to use its unique expertise and system-wide view – supported by a responsibility to maintain the system's security – to deliver a comprehensive roadmap of how a climate-neutral Europe looks.

Our values

ENTSO-E acts in **solidarity** as a community of TSOs united by a shared **responsibility.**

As the professional association of independent and neutral regulated entities acting under a clear legal mandate, ENTSO-E serves the interests of society by **optimising social welfare** in its dimensions of safety, economy, environment, and performance.

ENTSO-E is committed to working with the highest technical rigour as well as developing sustainable and **innovative responses to prepare for the future** and overcoming the challenges of keeping the power system secure in a climate-neutral Europe. In all its activities, ENTSO-E acts with **transparency** and in a trustworthy dialogue with legislative and regulatory decision makers and stakeholders.

Our contributions

ENTSO-E supports the cooperation among its members at European and regional levels. Over the past decades, TSOs have undertaken initiatives to increase their cooperation in network planning, operation and market integration, thereby successfully contributing to meeting EU climate and energy targets.

To carry out its **legally mandated tasks**, ENTSO-E's key responsibilities include the following:

- Development and implementation of standards, network codes, platforms and tools to ensure secure system and market operation as well as integration of renewable energy;
- Assessment of the adequacy of the system in different timeframes;
- Coordination of the planning and development of infrastructures at the European level (Ten-Year Network Development Plans, TYNDPs);
- Coordination of research, development and innovation activities of TSOs;
- Development of platforms to enable the transparent sharing of data with market participants.

ENTSO-E supports its members in the **implementation and monitoring** of the agreed common rules.

ENTSO-E is the common voice of European TSOs and provides expert contributions and a constructive view to energy debates to support policymakers in making informed decisions.

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Ten-Year Network Development Plan 2022

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Hyperlinks
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ENTSO-E Technopedia
www.entsoe.eu/Technopedia/

Questions?

Contact us as at **tyndp@entsoe.eu**

Contents

Stakeholders' involvement in TYNDP 2022

TYNDP 2022 scenarios

External stakeholders representing the gas and electricity industries, customers and environmental NGOs, regulators, national governments and the European Commission were key in building an ambitious set of scenarios. Two public consultations, on the scenario storylines and draft scenarios, and four workshops and webinars allowed the collection of stakeholders' input. The European Commission and ACER contributed via the TYNDP Cooperation Platform and high-level meetings. The Scenarios will be submitted to ACER in Q4 2022 for a formal opinion alongside the draft TYNDP 2022 package. For a detailed overview of stakeholders' engagement in TYNDP 2022 scenario building, see Chapter 4 of the TYNDP 2022 Scenario Report.

CBA methodology

The '3rd CBA guideline for the cost-benefit analysis of grid development projects' (CBA 3.0 or 3rd CBA guideline) was drafted by ENTSO-E in compliance with the requirements of the EU Regulation (EU) 347/2013. The cost-benefit analysis (CBA) guidelines are the result of an extensive consultation process involving the general public, stakeholder organisations, national authorities, their national regulatory authorities, ACER, and the European Commission.

In December 2017, ENTSO-E invited external stakeholders to participate in three workstreams dealing with specific aspects of the CBA, including security of supply (divided between adequacy, stability and ancillary services), socio-economic welfare (SEW), and storage. The outcome of this work has served as a starting point and as an extended consultation process for drafting the 3rd CBA Guideline. The draft was submitted for public consultation between November and December 2020. For more information on the involvement of stakeholders in the development of the 3rd CBA Guideline, see, Consideration on the inclusion of input from stakeholders in the development of CBA 3.0.

Related documents:

- Comments received during the public consultation and ENTSO-E's assessment of the comments

TYNDP 2022 CBA Implementation Guidelines

ENTSO-E consulted stakeholders on the main proposed improvements to the TYNDP 2022 Implementation Guidelines from 30 November 2021 to 7 January 2022. All questions and answers are available in Appendix 3. Below is an overview of the feedback received and how it impacted the guidelines.

General comments on the concept of the CBA Implementation Guideline:

While the organisation of a public consultation on key topics related to the Implementation Guidelines was positively received, respondents regretted that the full Implementation Guideline itself was not released for early consultation (before its release as part of the full TYNDP package). One stakeholder pointed out that the changes from the 2020 version of the Implementation Guideline should be made clearly visible. ENTSO-E addressed this comment by including in the Implementation Guidelines an overview of the main changes compared to 2020. The TYNDP 2022 Implementation Guidelines were released in draft form in March 2022, much earlier than in previous TYNDPs.

One stakeholder took the view that it should not be the role of an implementation guideline to propose improvements to the methodology. ENTSO-E clarified that the modularity of the CBA Guideline / Implementation Guideline approach is meant to allow for the introduction of minor changes and specific details in the Implementation Guideline, while the CBA Guidelines (CBA GL) set the main concepts. Therefore, the changes introduced in the Implementation Guideline do not go beyond the scope allowed by the CBA GL because the CBA GL explicitly refers to and relies on the study-specific implementation guideline.

On the proposed approach to assessing security of supply:

Stakeholders asked for additional justification for the proposed approach of using 15 randomised yearly availabilities of thermal power plants. To address this comment, the draft Implementation Guideline explains the reasoning behind the choice of Monte-Carlo years, which is based on a trade-off between precision of the results and operational feasibility of the computations.

Stakeholders also noted that climate years in the pan-European climate database (PECD) should reflect climate change. An update of the PECD to cope with the effects of climate change will be investigated in future TYNDPs.

In respect of the value of lost load and cost of new entry, stakeholders pointed out that these should both be sufficiently high to provide a strong investment signal and generally agreed with the default values proposed by ENTSO-E if no value has yet been computed at the country level.

On project-level indicators:

Some stakeholders wondered why some project-level indicators could not be computed by ENTSO-E while they are being addressed in studies by other stakeholders. ENTSO-E clarified that, on the one hand, the framework of the TYNDP, which comes with tight deadlines, does not allow the inclusion of overly complex studies. On the other hand, indicators cannot be overly simplified; they must be sufficiently detailed to support the PCI process. Project-level indicators are an imperfect solution, and whether they can be assessed by ENTSO-E will be investigated in a future edition of the CBA Guidelines.

On the climate years chosen to perform the CBA:

Stakeholders suggested that using more climate years would yield more robust results, to which ENTSO-E replied that the chosen number of three climate years represents a compromise between the quality of results and operational feasibility. Whether the number of climate years could be expanded in future is a matter to be assessed when planning for TYNDP 2024.

Stakeholders also asked for clarification on how the chosen climate years were selected and suggested that each year should be analysed regionally to show sufficient variation in the temperature, solar and wind data across Europe. ENTSO-E clarified that the selection was an application of the bidding zone review (BZR) methodology.

On the time horizons studied:

A majority of respondents called for the assessment of projects to be extended to the 2050 horizon, because meeting the 2050 climate objectives will require significant effort translating into major challenges for the power sector. Time horizons studied in the CBA are determined in part by rules set in the CBA Guideline, there is therefore limited flexibility. In addition, the further into the future the projection, the more scenarios have to be assessed to provide useful results, making a study of the 2050 horizon too resource-intensive.

On the reference grids:

From stakeholders' responses, it appears that the concept of a reference grid and its role in the assessment of projects should be better explained. The same goes for the criteria governing the construction of reference grids, specified in the CBA Guideline, and the provision of projects' commissioning years. To address this issue, the draft Implementation Guideline released after this consultation contains a specific part on the reference grid.

On the use of AC or DC for load-flow calculations:

Few stakeholders expressed views on this very technical question. Two stakeholders expressed their preference for AC modelling, one because AC modelling supposedly allows for a more detailed assessment of network performance, the other because AC requires fewer assumptions than DC-based load-flows. The draft TYNDP 2022 Implementation Guideline allows for the use of either AC or DC for load-flow calculations. Indeed, analysis shows that the DC power flow with customised voltage patterns is as appropriate for long-term studies as the AC power flow approach.

A stakeholder further recommended assessing projects' losses in the long-term, as it can help in deciding between alternative technology solutions. In TYNDP 2022, because of the complexity of computations, losses are computed only for the National Trends 2030 scenario.

On internal redispatch calculations:

A majority of respondents called for ENTSO-E to develop a central analysis and calculation of redispatch. ENTSO-E will investigate possible solutions for calculating redispatch on a centralised level in future editions.

On offshore hybrid projects:

Modelling approach: Some respondents were of the view that both the offshore bidding zone (OBZ) and home market (HM) approaches should be allowed, while other stakeholders called for prioritising the OBZ approach. In TYNDP 2022, we allowed promoters to choose their preferred option.

Should hybrid projects be treated as enablers for the achievement of policy goals: Some stakeholders agree that offshore hybrid projects should be treated as enablers, allowing the installation of RES to the European power system. However, the risk of double counting should be recognised and avoided. Others point out that RES inclusion is already covered by indicator B2, which requires the assessment of projects' contributions to the EU climate or decarbonisation objectives.

On the assessment of hybrid projects, one stakeholder took the view that they should be allowed to assess hybrid projects by adding or removing capacity to/from scenarios. Another stakeholder called for a METIS-type study proving that such projects are part of the optimal energy mix. Both ideas will be considered when further reviewing our methodology to assess hybrid projects.

On interlinkage of gas and electricity:

ENTSO-E proposed a new indicator monetising the amount of hydrogen produced by P2G units. Stakeholders called for caution and further analysis. ENTSO-E recalled that this new methodology is a pilot in TYNDP 2022, which will be included in future CBA Guidelines if its implementation in 2022 is successful.

On other relevant indicators that should be included in the CBA:

Two stakeholders asked for an indicator that captures the use of network optimisation technologies. One stakeholder was not in favour of the creation of many additional indicators, as it creates the risk of double counting and could put out of sight economic efficiency. Stakeholders also proposed improvements to existing indicators, including a SEW indicator calculated with both an energy demand constraint and others reflecting FCR, automatic frequency regulation reserve (aFRR) and manual frequency regulation reserve (mFRR) demand. Another request is to monetise avoided non-CO_2 emissions.

Some stakeholders called for the 'energy efficiency first' principle to be enshrined in the CBA approach. Applying this principle is a requirement in the revised TEN-E regulation and will therefore be implemented in the 4th version of the CBA Guidelines.

On the new methodology to assess commissioning years:

Stakeholders asked for further information on the proposed methodology, which was new in the draft version of the TYNDP 2022 Implementation Guidelines. One stakeholder pointed out that national and regional differences may impact the results. When asked whether the length of a project has a major influence on its duration, stakeholders were unanimous in answering that public acceptance, environmental aspects and permitting processes have much more impact. After consideration of comments received from stakeholders, project promoters and ACER, ENTSO-E decided to postpone the pilot implementation of this new methodology to TYNDP 2024. It has therefore been removed from the TYNDP 2022 Implementation Guidelines, but is included in the draft version of the CBA 4.0 Guidelines under public consultation in December 2022 – January 2023.

Methodology for the identification of system needs

On 14 October 2021, ENTSO-E presented the proposed methodology to stakeholders to identify system needs in TYNDP 2022. The webinar brought together 120 stakeholders and generated over 60 questions and comments in a lively discussion. Below is an overview of the main comments received and of our responses where appropriate. The exhaustive list of comments and our responses can be found in Appendix 2.

On the choice of time horizons studied:

ENTSO-E presented its plan to assess needs over the 2030 and 2040 time horizons. Many stakeholders felt ENTSO-E should develop plans for the 2050 horizon and that 2030 is too soon to provide relevant information for project promoters, as infrastructure projects generally require more than eight years to be financed, planned and built. ENTSO-E clarified that the choice of time horizons is justified, first, by the need to align with the horizons studied in the next step of the TYNDP, the CBA of projects. Time horizons studied in the CBA are determined in part by rules set in the CBA Guideline, a methodology approved by the European Commission, and by the requirement to provide data to support the European Projects of Common Interest process, which looks at the 2030 horizon. There is, therefore, limited flexibility. The 2050 horizon has been discarded in TYNDP 2022 because the further into the future the projection, the more scenarios have to be assessed to provide useful results, making the study too resource-intensive.

On scenarios:

Stakeholders asked whether the needs study would be performed in respect of all three TYNDP 2022 scenarios, thus delivering three different optimised power system configurations. Others suggested that the analysis should be repeated for more ambitious scenarios, as the National Trends scenario falls behind targets as countries increase their climate ambitions. ENTSO-E replied that the 2022 system needs study is performed only on the National Trends scenario, which is more ambitious than the same scenario assessed in TYNDP 2020. We expect that the same study in TYNDP 2024 would look at a yet more ambitious scenario.

On the system needs study within the TYNDP process and its interrelation with the CBA:

In response to a question seeking clarification about the process, ENTSO-E explained that the assessment of system needs and the CBA are two distinct, complementary steps that help policymakers identify the most relevant projects at a given time. Additionally, one person asked why the market analysis is based only on SEW. Considerations of system resilience or other societal and environmental benefits are not included in the system needs analysis, but are considered in the next step, the CBA.

One comment requested a second window for submitting projects to the TYNDP process after the system needs study. This has been done in TYNDP 2020 but is not planned in TYNDP 2022 because promoters are expected to propose any project addressing needs identified in 2022 in TYNDP 2024.

On the consideration of storage and peaking units in 2040:

In response to a question about the flexibility of the power system analysis in the system needs study, it was explained that ENTSO-E will include flexibility solutions for the first time in its analysis in the system needs study of TYNDP 2022. A participant asked why only hydro pumps and battery storage technologies are being considered and proposed thermal storage with synchronous machines, which can provide inertia in both operation modes. If the 2022 study is successful, ENTSO-E may consider including additional flexibilities in future studies. However, integrating flexibilities renders the modelling extremely complex. A further comment on flexibility beyond storage and generation technologies was that smart transmission is essential and must be taken into account.

On the 70% rule:

A questioner asked why the 70 % rule on cross-zonal capacity will not be taken into account and suggested that it may potentially result in an overestimation of identified system needs. ENTSO-E considers that currently, there is not sufficient maturity or alignment of views on implementing this rule in current models. There are ongoing workstreams with regulators and other actors to address this issue.

On offshore needs:

Stakeholders were asked about capturing offshore benefits in future studies. Indeed, the current system-needs methodology does not allow for the identification of needs for hybrid offshore infrastructure. ENTSO-E explained that it has been developing a methodology to capture the benefits of such infrastructure, which will be released with TYNDP 2022 but only implemented in TYNDP 2024.

On transparency and availability of datasets

One commenter asked for ENTSO-E to publish all data, including costs estimates for candidates. Another asked for the zonal clustered model to be published to allow complementary research, and a third asked for the choice of climate years to be made available. All this information has been or will be published. Not all information may be published on ENTSO_E's website, but stakeholders are welcome to contact ENTSO-E if they are interested in obtaining particular information. All data used in the system needs study will be submitted for public consultation alongside the TYNDP 2022 package between July and September 2022.

Public consultation on the draft TYNDP 2022 package

The draft TYNDP 2022 was submitted to public consultation from 25 July to 16 September 2022 and a webinar took place on 6 September. ENTSO-E has considered and answered to the comments received and released in January 2023 an updated version of the TYNDP 2022 package to ACER for a formal Opinion.

After reception of ACER's Opinion, expected in Q1 2023, the TYNDP 2022 package will be further edited considering ACER's comments and will be published in its final form in Q2 2023.

Webinar

ENTSO-E organised a public webinar during the public consultation period to present the TYNDP 2022 to stakeholders. It presented TYNDP 2022 with a pan-European scope and a special focus on the system needs study. A second webinar in January 2023 will take stock of the comments received in the public consultation and will go more into details of future challenges and opportunities, with a regional angle.

Related documents:

- Webinar on TYNDP 2022, 6 September 2022: recording | slides | Q&A with the audience
- Webinar on regional challenges and opportunities, January 2023: all material will be available on tyndp.entsoe.eu

Public consultation on the draft TYNDP 2022 package

Respondents

The public consultation gathered feedback from 14 stakeholders, representing a diverse set of interests and viewpoints (Figure 1).

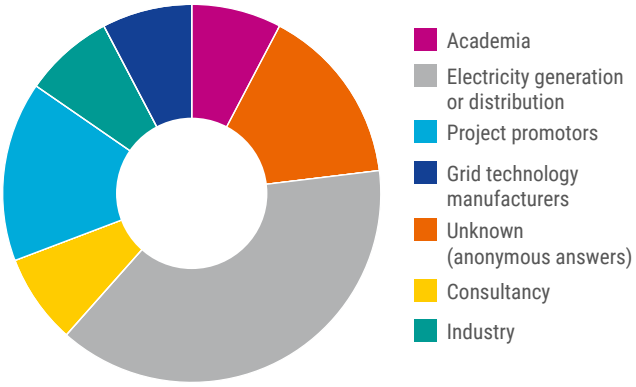

Figure 1 – Respondents to the public consultation on the draft TYNDP 2022 by category

Most respondents consult TYNDP 2022 for information on scenarios, transmission and storage projects and future system needs (Figure 2).

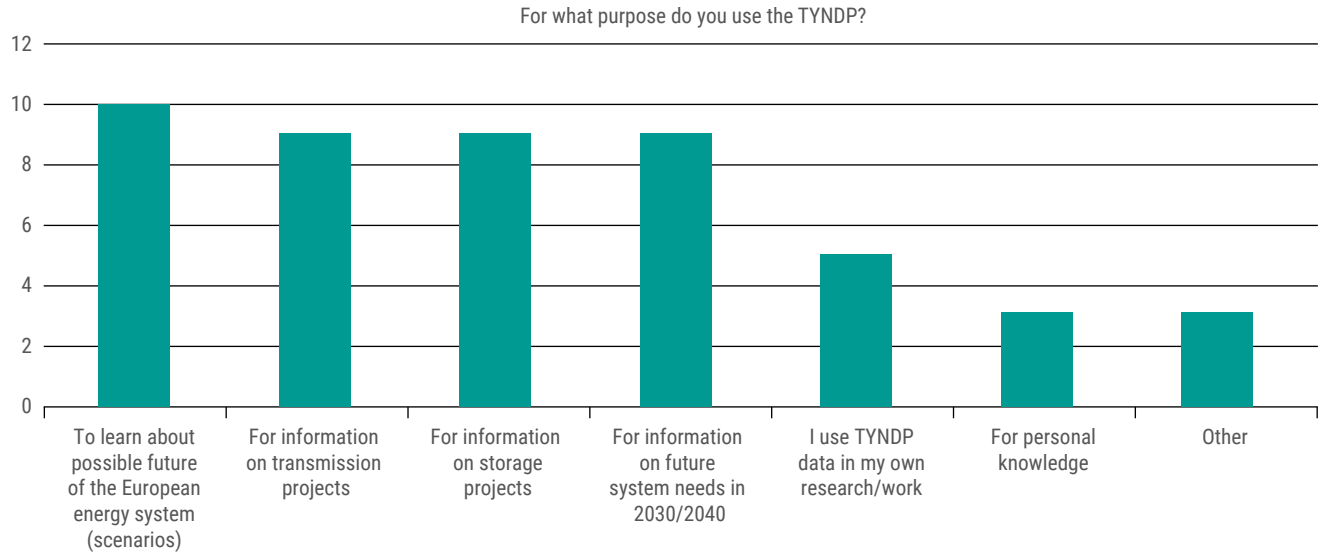

Figure 2 – Respondents answers to the question "For what purpose do you use the TYNDP?"

The tone of the feedback expressed by stakeholders is spread as follows:

- Positive statements (27,3 %): comments that welcome positive aspects of TYNDP under consultation, such as methodological improvements.
- Neutral comments (36,4 %): comments that report general consideration without expressing either positive or negative opinion about the TYNDP.
- Calls for improvement (36,4 %): comments that express reservations, ask for more transparency or express general advice for improvements of assumptions, methodologies or communication.

Overview of stakeholders comments

Below is an overview of the main comments received during the TYNDP 2022 public consultation process, grouped by topic. Stakeholders' comments cover not only the TYNDP 2022 itself but also the CBA Guideline 3.0, which is distinct from the TYNDP 2022.

NB: What follows is only an overview of the most frequently raised points. For an exhaustive list of stakeholders feedback on TYNDP 2022, please refer to the comments themselves in Appendix 4.

On scenarios

Several stakeholders commented on TYNDP 2022 scenarios, which were previously subjected to a separate and extensive consultation process. Readers are asked to refer to the Official response to ENTSO-E & ENTSOG 2022 TYNDP Scenarios consultation dated 7 October 2021 – 18 November 2021 (link).

On the identification of system needs

Overall, stakeholders express general appreciation of the TYNDP's analysis of system needs.

Stakeholders welcome the methodological improvements brought in 2022. Especially noted by stakeholders are the inclusion of storage in the investment candidates and the consideration of 3 different climate years in 2030 and 10 different climate years in 2040. Stakeholders also welcome the study on operational challenges that accompanies the System needs study. The development of a specific draft methodology to evaluate the benefits of offshore hybrid assets is also seen positively.

However, several stakeholders express reservations and proposals for improvement. One such request concerns the investment candidates used for the study. One stakeholder deplores that the list is largely based on projects brought forward by developers, while another proposes that demand side flexibility should also be considered, in addition to cross-border capacity increases and storage. Regarding transparency of the study's input and methodology, one stakeholder wishes for explanation on the internal reinforcement costs associated to each project.

Regarding the scenarios assessed in the TYNDP system needs study (National Trends 2030 and 2040, based on EU Member States National Energy and Climate Plans (NECPs)), stakeholders note that NECPs are a good starting point but point out that, because NECPs fail to meet the politically agreed climate and energy targets and ambitions, identified needs are probably underestimated. In addition, the National Trends scenario was developed before the most recent EU energy and climate legislation was agreed, and long before Europe's decision to become independent from Russian fossil fuels. Two stakeholders welcome the comparison made with Distributed Energy.

When the system needs study identified a "gap" – a border with a need but no or not enough projects under development - one stakeholder proposes that "these clear investment gaps should be further analysed e. g. in the Regional Investment Plans. Solutions should be sought to fill these gaps with additional projects either on these borders or on other borders in the region." For the first time in 2022 Regional Investment Plans include a part on future challenges in the region, looking at possible future studies that may be performed to address the needs within the region. In the context of preparing for TYNDP 2024 ENTSO-E will review the role of Regional Investment plans in the TYNDP overall and in the system needs study in particular.

On transparency and stakeholders engagement

Transparency and clarity of input data and of results is one of the most commented topic.

Regarding input data, many comments concern scenarios data and demonstrate an overall need to make it easier for stakeholders to locate the data they need, and to understand which datasets are produced (or not) as part of the scenario-building process for National Trends on one side, and for Distributed Energy and Global Ambition on the other.

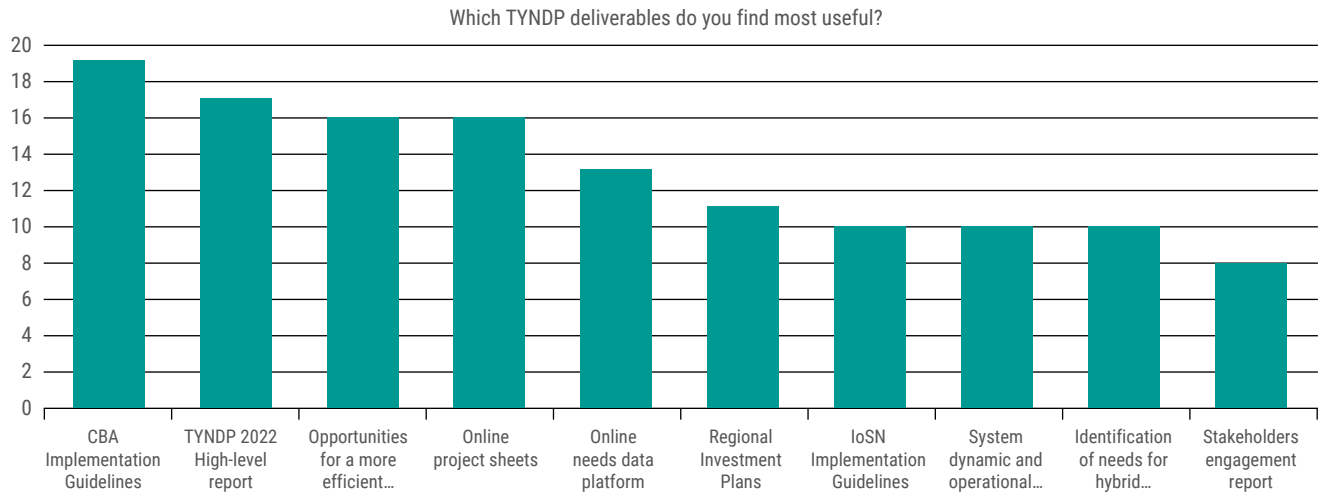

Figure 3 – Answers received in the TYNDP 2022 public consultation to the question "Which TYNDP deliverables do you find most useful?"

Stakeholders propose improvements for the scenarios data visualisation platform, including detailed explanation or descriptions and further details on the assumptions to help improve the user's understanding of the scenarios.

Finally, one stakeholder proposes to set up common formats in reports and excel files between TYNDP and ERAA, and to explain further the technical interlink between the two studies.

Regarding outputs (documents and online platforms presenting TYNDP results), stakeholders appreciate the clear structure of the TYNDP 2022 package. Reports are considered as clear and understandable. However, one stakeholder notes that it takes some expert knowledge to understand all the details. When asked to rate the usefulness of reports and platforms of the TYNDP 2022 package, stakeholders places the TYNDP 2022 Implementation Guidelines first, before the TYNDP high-level report and the System needs report (Figure 3).

The webinar organised on 6 September 2022 was appreciated and considered as very helpful. One stakeholder calls for regional and national events that concentrate on the regional and national issues, in addition to the European-level stakeholder events.

Is the TYNDP compatible with the EU Green Deal?

Most stakeholders take the view that the TYNDP currently is not compatible with the EU Green Deal, for various reasons related mostly to its scenarios.

One stakeholder points out that "the TYNDP has to capture a large scope of possible futures to highlight the risks to invest in infrastructures and explore all the pathways of decarbonisation", adding that the scenarios considered in the TYNDP do not meet these objectives because there are too high levels of hydrogen in scenarios DE and GA while there are many uncertainties concerning the development of hydrogen. Another stakeholder points out that, though in principle compatible with 2050 climate neutrality, TYNDP 2022 scenarios have less ambitious electrification rates. Lastly, TYNDP 2022 was built based on scenarios that were developed before the war in Ukraine started, rendering the scenarios largely outdated because the EU climate and energy landscape is very different today than it was a year ago.

Another stakeholder highlights as major concern the assumptions in the draft methodology for the Identification of offshore hybrid needs in the TYNDP system needs study. ENTSO-E answered that the methodology for the assessment of hybrid investment candidates is a first step in the introduction of hybrid offshore systems in the identification of infrastructure gap analysis. ENTSO-E intend to continue the evolution of the methodology in order to include more complex systems, better reflecting the configuration of the future offshore grid.

Public consultation on cost-benefit analysis results

Because not all CBA results were available when the 6 weeks public consultation opened in July, ENTSO-E organised a short consultation on CBA results in January to allow stakeholders to provide additional feedback. No comments were received on CBA results (the only comment made pertained to scenarios data, and can be found in Appendix 5).

Project promoters in TYNDP 2022

Project promoters are key stakeholders in the TYNDP process, and ENTSO-E has put in place dedicated communication activities to ensure a smooth sharing of information, both from ENTSO-E to promoters and from promoters to ENTSO-E.

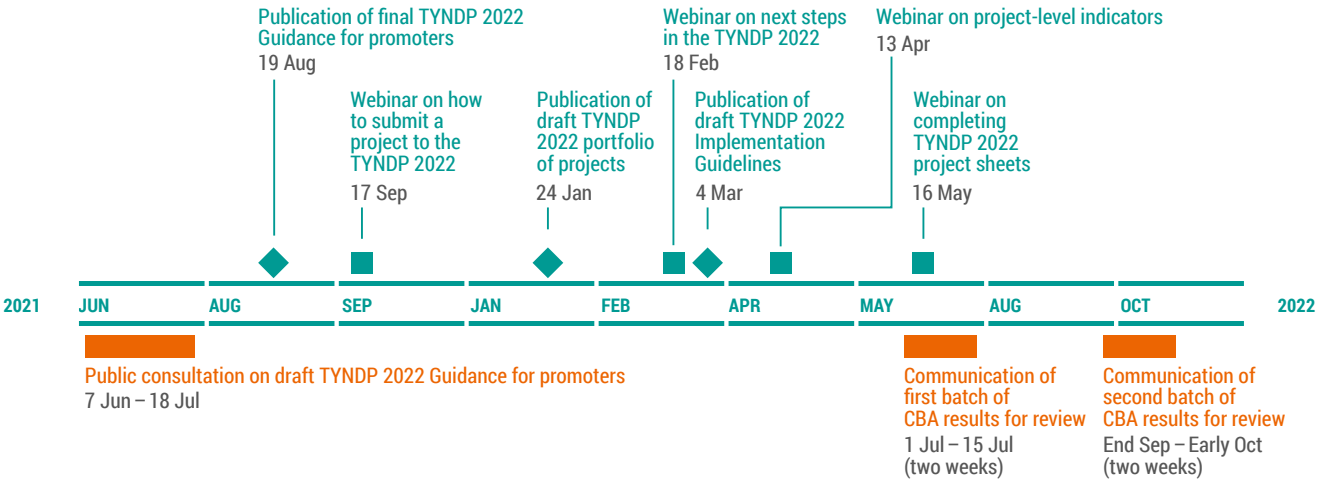

Figure 4 – Communication to promoters: release of key documents and webinar

Figure 5 – Collection of data from TYNDP 2022 promoters

Selection of TYNDP 2022 projects

The eligibility of projects for assessment in the TYNDP 2022 is determined according to the rules and criteria specified in the TYNDP 2022 Guidance for applicants – Transmission and storage projects promoters – Criteria for applications and their treatment. Requirements related to the project promoter's seriousness, demonstrated by documents relating to the company's legal existence, financial information and technical expertise, and the project's characteristics (its status, whether featured in the most recent PCI list or in a national development plan or confirmed in feasibility studies). A draft version of the guidance was first submitted for public consultation in June and July 2021 before being edited based on the comments received and published in its final version in August 2021.

Project promoters were then asked to propose projects during a one-month window between 15 September and 15 October 2021.

Among the projects for which applications were received for inclusion in TYNDP 2022, seven were not in compliance with the mandatory administrative criteria and were therefore not accepted in the TYNDP 2022. The list of non-accepted projects and the specific reasons for non-compliance are included in the TYNDP 2022 project portfolio.

TYNDP projects online platform

The collection of project data is managed via an online platform, accessible at https://tyndp2022-project-platform.azurewebsites.net/. The platform is also used to share CBA results with promoters. Credentials to access the platform are available to promoters' single point of contact upon request to ENTSO-E.

Promoters' corner

A webpage, or "promoters" corner' is available at https://tyndp.entsoe.eu and aims to keep project promoters informed of key steps of the TYNDP 2022 process. The page centralises all information, documents, and frequently asked questions of interest to promoters. The page is regularly updated with the latest information on project status, the most recent data collected, and webinar materials. New promoters can also subscribe to the mailing list of project promoters via the promoters' corner. Promoters who contemplate submitting a project to the TYNDP 2024 are encouraged to subscribe to that list to stay up to date.

Documents made available to promoters in the TYNDP 2022 process

On submitting a project to the TYNDP 2022

- Guidance for applicants: Transmission and storage project promoters criteria for applications and their treatment in the TYNDP 2022
- Webinar: "Submitting a project to TYNDP 2022" – recording and slides
- Webinar: "Next steps for project promoters in the TYNDP 2022 process" – recording and slides
- Frequently asked questions for project promoters of TYNDP 2022 projects

On completing the project sheets

- Webinar: "Completing TYNDP 2022 project sheets" – recording and slides

On submitting Project-level indicators

- Webinar: "Project-level indicators" – recording and slides

Appendix 1 – Comments received in the public consultation on the TYNDP 2022 Guidance for promoters and ENTSO-E's responses

Q1. General comments

Anonymous

Page 8, Section 2.1 Eligibility criteria for all projects: The last section, "Project promoters of storage projects", is in bold; we think there is an error, and this should be option c) for the eligibility criteria and we would like to ask for correction. Could you define PHES in your document?

ENTSO-E's answer: In Section 2.1. the last section is corrected by being designated as Option C; thank you very much for your remarks.

For the definition of PHES (Pumped Heat Electrical Storage), please see the following quote from Energy Storage Association (ESA)[1]. Please note that PHES is removed from the document to avoid any confusion, as the technologies are not limited to PHES.

"In Pumped Heat Electrical Storage (PHES), electricity is used to drive a storage engine connected to two large thermal stores. To store electricity, the electrical energy drives a heat pump, which pumps heat from the "cold store" to the "hot store" (similar to the operation of a refrigerator). To recover the energy, the heat pump is reversed to become a heat engine. The engine takes heat from the hot store, delivers waste heat to the cold store, and produces mechanical work. When recovering electricity, the heat engine drives a generator.

PHES requires the following elements: two low-cost (usually steel) tanks filled with mineral particulate (gravel-sized particles of crushed rock) and a means of efficiently compressing and expanding gas. A closed circuit filled with the working gas connects the two stores, the compressor and the expander. A monatomic gas such as argon is ideal as the working gas as it heats/cools much more than air for the same pressure increase/drop – this, in turn, significantly reduces the storage cost.

The process proceeds as follows: the argon, at ambient pressure and temperature (top left limb of the circuit on the diagram), enters the compressor (diagram shows a rotating compressor symbol – all equipment is in fact reciprocating). The compressor is driven by a motor/ generator (top) using the electricity that needs to be stored (yellow arrows at top). The argon is compressed to 12 bar, +500 °C. It enters the top of the hot storage vessel and flows slowly (typically less than 0.3 m/s) through the particulate, heating the particulate and cooling the gas. As the particulate heats up, a hot front moves down the tank (at approximately 1 m/hour). At the bottom of the tank, the argon exits, still at nearly 12 bar but now at ambient temperature. It then enters the expander (bottom) and is expanded back to ambient pressure, cooling to minus –160 °C. The argon then enters the bottom of the cold vessel and flows slowly up, cooling the particulate and itself being warmed. It leaves the top of the tank back at ambient pressure and temperature.

To recover the power (i. e. discharge), the gas flow (and all arrows on the diagram) is simply reversed. Argon at ambient temperature and pressure enters the cold tank and flows slowly down through it, warming the particulate and itself becoming cold. It leaves the bottom of the tank at –160 °C and enters the compressor. It is compressed to 12 bar, heating back up to ambient temperature. It then enters the bottom of the hot tank. It flows up, cooling the particulate and itself being warmed to +500 °C. The hot pressurised gas then enters the expander, where it gives up its energy-producing work, which drives the motor/generator. The expected AC to AC round trip efficiency is 75 – 80 %.

PHES can address markets that require response times in the region of minutes upwards. The system uses gravel as the storage medium, so it offers a very low-cost storage solution. There are no potential supply constraints on any of the materials used in this system. Plant size is expected to be in the range of 2 – 5 MW per unit. Grouping of units can provide GW-sized installations. This covers all markets currently addressed by pumped hydro and a number of others that are suitable for local distribution, for example, voltage support. Technology is in development stage and commercial systems are due in 2014".

1 ESA, Retrieved on 2 August 2021, https://energystorage.org/why-energy-storage/technologies/pumped-heat-electrical-storage-phes/

Q2. Please share here any comment or question on the Guidance – Specific comments on technical criteria (and related documentation)

Anonymous

Page 17 sets out the requirement that the project shall provide at least 225 MW installed capacity. We ask you to consider a reduction of the requirement to 100 MW. There are storage systems that could still provide the net annual electricity generation of 250 GWh/year with a 100 MW installed capacity.

Page 19 states, "the promoter indicates whether the project presents a natural inflow (for PHES)". We do not know what that means. We would like to ask for clarification. Natural inflow is the storage inflow that comes separately from the main source (river where there is pump storage). An example of the pump storage could be melting snow.

ENTSO-E's answer: As the required installed capacity is linked to the current TEN-E regulation, we cannot change this requirement. TEN-E regulation[2] Annex IV (1) (b) reads: "b) for electricity storage, the project provides at least 225 MW installed capacity and has a storage capacity that allows a net annual electricity generation of 250 Gigawatt-hours/year". For the second part of the question (regarding PHES), please see our response to the previous question.

currENT Europe

We suggest adding "digitalisation projects" as a third category, recognising that new transmission capacity, more storage, and enhanced utilisation through digitalisation are the three elements of the infrastructure transition.

In Section 2.2.2, in the estimation of an increase in NTC, we suggest adding the requirement that the effects of grid-enhancing technologies be considered as a supplement or alternative to building new grids. This change aims to ensure compliance with the efficiency first principle.

Many grid-enhancing technologies and innovative solutions have medium to high TRLs and are ready for wide-scale implementation but have not been included in TYNDP projects in past years. The TYNDP 2022 process should support the inclusion of such technologies and solutions, in addition to conventional infrastructure. The ENTSO-E Technopedia is a useful reference to the wide range of technologies available.

ENTSO-E's answer: In the current TYNDP, there are several technologies that apply to digitalisation that can be part and are already part of the project and process (For example, HighTª conductors, DLR, FACTs, and SSSC).

Regarding smart grid projects, as the current TEN-E regulation does not require their inclusion, we have not included them in the TYNDP thus far. We do recognise the importance of smart grid projects and their role in the infrastructure transition; however, with the current TYNDP design (methodology and calculation method) and timeframe, the inclusion of these projects is not possible for this TYNDP 2022.

2 Regulation (EU) No 347/2013, guidelines for trans-European energy infrastructure and repealing Decision No 1364/2006/EC and amending Regulations (EC) No 713/2009, (EC) No 714/2009 and (EC) No 715/2009, Annex IV (1) (b)., https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R0347&from=en

Q3. Please share here any comment or question on the guidance – Specific comments on project assessment, review procedure and data handling

3d-Hydro Engineering GmbH

With regard to CBA:

1. The experience from past CBA shows that the methodology for calculation of the various indicators is available very (or too) late in the process. We propose communicating the methodologies as early as possible to give promoters sufficient time to calculate the required figures.

2. Please try to monetise as many indicators as possible. In particular, avoided cost of non-greenhouse-gas emissions, based on EEA data, shows beneficial effects to the projects.

ENTSO-E's answer: The indicators for the CBA assessment and their underlying approach are included in the CBA Guideline. This is not part of the consultation but is a separate guideline that is referenced in the Project Promoters Guideline. The 3rd ENTSO-E Guideline for the CBA has been submitted to the European Commission for approval. Please find, for your information, the following clarification regarding the CBA:

1. The Implementation guidance for TYNDP 2022 will be completed and published before the initiation of the CBA process.

2. A monetisation of the non-CO_2 indicator is currently not proposed in this methodology. This is because it is unlikely that future improvements in emission reductions due to filters or increases in efficiency will have a comparable effect at lower costs. When monetising the non-CO_2 indicator, a project might become beneficial, or even non-beneficial, simply because of this impact. Therefore, it can be strongly impacted by future technologies. However, at the moment, no such technologies are in place, and the non-CO_2 indicator has to be shown on a quantified basis in order to complement the CBA assessment.

currENT Europe

Project Assessment: Project Promoters must have the flexibility to adapt, change or propose new solutions if a better solution becomes available or is identified. Given that innovation can be commercialised or proven at scale in a very short amount of time, innovative or new technologies will continue to become viable solutions for Europe during the time between projects being proposed to the TYNDP and their implementation on the grid (often three years or more). To ensure that the best solutions for society are ultimately delivered, the TYNDP process must provide flexibility to promoters to easily adapt, change, or propose new solutions at any point if they become available or a superior solution that meets the same system needs more efficiently.

The "cost of delay" must be reflected in the assessment of TYNDP projects, and flexible solutions must be fairly valued. currENT advocates for the optimisation and reinforcement of grids as a first step in grid development. While new grids are essential to meet certain long-term system needs, there is often scope to also utilise available capacity on the existing grid using flexible grid-enhancing solutions. This can deliver earlier benefits to consumers while new infrastructure is "in permitting" or under construction (e. g., by reducing constraint costs) and may, in some cases, even defer or eliminate the need for the new infrastructure. The value of reducing carbon emissions in the near term and making progress towards a high-RES grid now is far greater than reducing the same carbon emissions in 10 years' time. This "cost of delay" associated with large infrastructure projects must be taken into account when considering which project should be taken forward to meet an identified system need.

Review Procedure/Assessment of existing projects: Project Promoters must have the flexibility to adapt, change or propose new solutions if a better solution becomes available or is identified. Given that innovation can be commercialised or proven at scale in a very short amount of time, innovative or new technologies will continue to become viable solutions for Europe between the time when projects are proposed to the TYNDP and their implementation on the grid (often 3 yrs+). To ensure that the best solutions for society are ultimately delivered, the TYNDP process must provide flexibility to promoters to easily adapt, change or propose new solutions at any point if new solutions become available or they identify a superior solution that meets the same system need more efficiently.

We propose that there should be greater recognition of the full range of cost-effective solutions that can provide additional capacity and that support optimising the use of the existing grid.

ENTSO-E's answer: The TYNDP project has a defined timeline and scope, which are set by the regulation. Considering its stringent requirements within the given timeline, it is not possible to take a flexible approach to project adaptation. Such an approach would cause inconsistencies in the following process of the TYNDP project (CBA calculation etc.) and would not allow timely delivery of the results. Any further modifications that might occur on the projects after the project data collection period can always be submitted to the TYNDP for the next cycle.

For the second part of your question, the indicators for the CBA assessment and the approach behind them are included in the CBA Guideline. This is not part of the consultation but a separate guideline that is referenced in the Project Promoters Guideline. The 3rd ENTSO-E Guideline for the CBA has been submitted to the European Commission for approval.

However, since the efficient use of the system is a pillar of ENTSO-E's approach to the energy transition, our CBA team will be informed about your comments in considering the next CBA Guidelines.

Appendix 2 – Comments received in the webinar on the system needs study methodology of 14 October 2021 and ENTSO-E's responses

How do you intend to capture offshore benefits in future studies?

ENTSO-E's answer: In the TYNDP 2020 and TYNDP 2022 System needs study, the wind and solar capacities are part of the scenarios, meaning that connection costs are treated as an externality, which, in the case of offshore wind, may represent an even higher deviation from overall system costs optimality. The study does not focus on the optimal connection of generation for all types. For that reason, so-called "hybrid solutions", that is, the combination of interconnections and offshore generation units, are not identified in the needs assessment.

However, throughout 2021 and 2022, ENTSO-E has been developing a methodology to capture the benefits of offshore hybrid infrastructure. The methodology and early results are released with the 2022 system-needs methodology report, and the new methodology implemented in TYNDP 2024.

In addition, the revised TEN-E regulation foresees the development of an Offshore Network Development Plan. ENTSO-E is currently working on the first such plan to be released around mid-2023.

Are there any constraints applied to the model, for example, taking into account maximum build rates of infrastructure?

ENTSO-E's answer: The costs of the investment candidates consider all factors. For capacity increases, candidates located on borders where the topology makes it difficult to build infrastructure will have costs that reflect that reality. As a result, it will be more difficult for these projects to be selected by the model.

I hope you learn from the fast-deteriorating British grid: https://www.storelectric.com/where-grid-regulation-went-wrong/

ENTSO-E's answer: Thank you for your comment.

What will the reference scenario be? Specifically, will the process be the same as in the rest of the TYNDP process?

ENTSO-E's answer: The National Trends scenario will be used both for the system needs study and to perform the CBA of projects, in both 2030 and 2040. The CBA is also planned to be performed on the Distributed Energy scenario.

Will the second window for providing the projects in the TYNDP process be opened after the system needs study?

ENTSO-E's answer: No, it will not. In TYNDP 2020, ENTSO-E organised a second submission window after the release of the system needs study, reserved for future projects (post-2035) and addressing needs identified in the study. The lesson learned from this process is that, while it allowed the identification of a few projects, it tended to create confusion for project promoters. In addition, the system needs study is to be released every two years, and ENTSO-E is of the view that promoters can identify projects and submit them to the next TYNDP; for example, they can develop a project for submission in TYNDP 2024 based on results of the 2022 system needs Study.

Regulations make the best project impossible; for example, connecting large renewables to grids through large-scale, long-duration inertial storage: contracts impossible

ENTSO-E's answer: Thank you for your comment.

How will the flexibility of the power system analysis in the system needs study be improved?

ENTSO-E's answer: For the first time, the system needs study of TYNDP 2022 ENTSO-E will include flexibility solutions in its analysis. Concretely, this is done by proposing optimiser storage and peaking units (with a set capacity and cost) in each country, together with cross-border solutions to increase transmission capacity. Solutions to increase flexibility and capacity will complete each other, and it is expected that the optimum identified will reflect needs in respect of both flexibility and capacity increases.

The timeline shows the CBA assessment starting in Q1 2022, so before the end of the System needs study.

Indeed, the CBA and the system needs study are parallel processes. Because the TYNDP must be released every two years, it follows a very tightly constrained process. For that reason, promoters who would like to propose solutions to the needs identified in a TYNDP are invited to do so for the next TYNDP. For example, promoters willing to propose transmission or storage solutions to some needs identified in TYNDP 2022 will be able to do so in TYNDP 2024. These projects will then be assessed in the 2024 process.

What is the expected impact of the system needs study process on the CBA assessment?

ENTSO-E's answer: The assessment of system needs and the CBA of projects are two distinct steps in the TYNDP process that complete each other to help policymakers identify the most relevant projects at a given time.

The system needs study looks at where the flow of electricity could be improved across Europe to reach decarbonisation targets and keep security and costs under control. It does not look into solutions to address the identified needs but only at where actions are needed. Identified needs can be addressed by any solution, including non-wire solutions.

ENTSO-E's answer: Identifying solutions to the needs is up to project promoters, who may propose their projects for assessment in the TYNDP's CBA of projects. ENTSO-E looks at how individual projects perform on a series of indicators. When selecting European Projects of Common Interest, policymakers consider both projects' CBA results and whether the project addresses a need identified in the system needs study.

Is there any News on the Issue of Inertia?

ENTSO-E's answer: Inertia is assessed in a separate study, which will be released together with the system needs study. The last edition of this study is available here.

How do you deal with the opportunities of system integration/sector coupling in the study?

ENTSO-E's answer: This is taken into account in the scenario via Power-to-Gas and vehicle-to-grid. For scenario data, please refer to the TYNDP 2022 scenarios data visualisation platform.

What are the parameters being tested, amps only or voltage, frequency and the like as well?

ENTSO-E's answer: The methodology used in the system needs study focuses on SEW and security of supply. The optimal set of capacity and flexibility increases is based on the contributions of the proposed increases to SEW and to ensure the security of supply. All investment candidates are defined only by their cost and capacities.

What can ENTSO-E do about regulations which, throughout Europe, make new large-scale long-duration inertial storage impossible to fund/contract?

ENTSO-E's answer: To discuss the effectiveness of European and national regulation, we advise you to address your comments to the European Commission and governments of EU Member States.

Will there be an option to de-select the CBA for a project as was possible last time for projects under construction?

ENTSO-E's answer: No, this possibility will not be available in TYNDP 2022.

A cost is required to see if the need is justified. Is this based on only lines, or are stations, cables, and PFC being used to determine if a need is justified.

Regarding increases in cross-border capacity, ENTSO-E collected data (capacity and costs) from project promoters of TYNDP 2022 projects in the fall of 2021. On borders where there were no or few existing planned investments, the collected data was completed using conceptual projects proposed by TSOs. The ultimate objective is to propose to the optimiser a list of investment candidates with realistic capacities and costs.

Cost assumptions include the CAPEX of the investment and the cost of any needed reinforcement of the internal transmission network.

As regards flexibility investments, the assumptions are based on data collected and consultations with TSOs within the scenario-building process. It is not broken down into distinct investments but takes the form of capacity in MW per market with associated costs.

What will be the improvement in the system needs study methodology to capture the full benefits of a connection between European and non-European countries (Tunisia–Italy).

ENTSO-E's answer: The list of capacity increases proposed to the optimiser includes all existing EU to non-EU country projects, provided they have PCI status. These investment candidates from EU to non-EU countries are included in the study, just like internal EU projects. ENTSO-E has a workstream with MedTSO to improve the modelling of North African countries in our studies.

The system needs definition, omits stability (based on real, not synthetic inertia), and skates over worst-case scenarios like kalte Dunkelflaute.

ENTSO-E's answer: Kalte dunkelflaute is taken into account by using multiple climate years chosen on a statistical basis in order to represent all types of years, including very cold years with low wind. ENTSO-E runs a separate study looking at inertia that will be published together with the system needs study.

There is inadequate calculation of trade-offs, for example, the need to triple grid sizes for renewables unless sufficient well-located large-scale long-duration inertial storage.

ENTSO-E's answer: Thank you for sharing your views. Could you please also share a source substantiating your statement.

Do you intend to implement flow-based market coupling into your model in the future?

ENTSO-E's answer: There is no such plan at the moment because we do not know how to do it or even if it is doable. The system needs study for the 2030 horizon uses a zonal model, which is another way to consider grid constraints in a market study.

How do you choose the zones for each country?

ENTSO-E's answer: There is no perfect zonal model. The perfect clustering would have one node per zone, which is not realistic. It is, therefore, necessary to cluster zones to form one node.

In the previous TYNDP, the zonal clustering was based on administrative boundaries, which led to suboptimal results in some countries.

In TYNDP 2022, the zonal clustering (used in the 2030 horizon only) seeks to represent grid contingencies. It represents a compromise between the level of detail (the more zones within a country, the more accurate the model) and the total number of zones (the more zones there are, the more difficult it is to run the model). Several criteria were considered, including which lines to put on equivalent links, the limiting elements, the number of zones for model convergence, and the capacities obtained after clustering.

Planning grid needs must not only be statistical but also (separately) designed for worst-case scenarios, for example, kalte dunkelflaute, when nearly all countries import by 2040

ENTSO-E's answer: Kalte dunkelflaute is taken into account by using multiple climate years chosen on a statistical basis in order to represent all types of years, including very cold years with low wind.

How are the benefits of each investment (of one interconnection, for example) evaluated if they are all operating at the same time with a co-optimisation?

ENTSO-E's answer: The benefits of specific investments are assessed in a second step, the CBA of individual projects, which is separate from the assessment of system needs. To know the impact of one single element in the system, interested stakeholders should turn to the TYNDP project sheets where ENTSO-E publishes results for a series of indicators, from the impact of a project in terms of increased SEW to CO_2 emissions reduction.

The system needs study does not look at the specific impact of each element. Instead, it seeks to prove that there exists a world in which investing in the energy system will deliver benefits. Doing so reveals the areas most likely to see these benefits. The system needs study is not an assessment of transmission or flexibility solutions. Identified needs can be addressed by any solution, including non-wire solutions.

The 2030 horizon is too short-term: grid-connected projects often take this long just to be financed, planned and built. The focus should be on the longer term of 30+ years.

ENTSO-E's answer: ENTSO-E understands there is an interest in the 2050 horizon among project promoters, industry, policymakers and investors. The system needs study looks at two horizons: 2030 and 2040.

_ 2030, because it is the horizon currently being investigated in the PCI process run by the European Commission, into which the TYNDP feeds.

_ 2040, because it is a relevant time horizon to identify needs that should be addressed by new projects that will be conceptualised and developed over the coming years. It is also a time horizon sufficiently close to today to allow the development of a set of technically sound scenarios.

ENTSO-E has considered the possibility of studying time horizons beyond 2040. The farther into the future the projections, the more uncertain the models become. The level of uncertainty that we would face in respect of 2050 and beyond renders the study too expensive in terms of work required for a properly representative projection.

In your modelling, the simple yet powerful way of calculating the need for storage should not be ignored: https://www.storelectric.com/calculating-the-need-for-storage/

ENTSO-E's answer: Thank you for sharing this link.

Smart technologies can increase transmission capacity and can be deployed faster than new-build transmission. How do studies take their benefits into account?

ENTSO-E's answer: The system needs study looks at cross-border capacity increases without considering whether the increase in capacity comes from a new line or from the increased efficiency of an existing line(s) with smart technology. The identified need for cross-border capacity increases may be addressed by a wide range of solutions, including smart technologies. Solutions to the needs are proposed by project promoters and may be assessed in the next phase of the TYNDP, project CBA.

Why are only hydro pump and battery storage considered? What about thermal storage with synchronous machines that can provide inertia in both operation modes?

ENTSO-E's answer: The inclusion of flexibilities in the 2022 system needs study is a pilot and represents a significant challenge for ENTSO-E's modelling experts and tools. That is why it was decided, as a first step, to limit the inclusion of flexibilities to storage and peaking. If the 2022 study is successful, we might consider the inclusion of additional flexibilities in future editions. However, it is important to understand that integrating flexibilities in the study (together with other improvements introduced in this edition, such as multiple climate years) renders the modelling extremely complex in the case of very long simulation times, to the extent that it might not be possible to integrate any additional element in the methodology.

Is it planned to use projected 2040 climate years (which could be significantly different given climate change at such time horizons)?

ENTSO-E's answer: Climate years are historical years. The methodology used to choose climate years is the one developed in the context of ENTSO-E's bidding zone study.

Are the climate years now probabilistic or still based on historical data?

ENTSO-E's answer: Climate years are historical years. The methodology used to choose climate years is the one developed in the context of ENTSO-E's bidding zone study.

To what degree do you seek national regulatory authority "buy in" to your methodology such that they accept this significant piece of work?

ENTSO-E's answer: ENTSO-E had regular exchanges with ACER in developing the system needs methodology for TYNDP 2022. The system needs study, results and methodology will be submitted to ACER for opinion alongside the rest of the TYNDP 2022 package.

Will you assess the impact of more interconnections on generator profitability?

ENTSO-E's answer: The system needs study looks at benefits for the entire European society, not at benefits for individual actors.

We would like both Swiss zones to be merged; how should we proceed?

ENTSO-E's answer: A study is currently underway to improve zonal clustering. In TYNDP 2022, the zonal clustering seeks to represent grid contingencies. Several criteria were considered, including which lines to put on equivalent links, the limiting elements, the number of zones for model convergence, and the capacities obtained after clustering.

Flexibility is not just storage and generation. Smart transmission tech is also essential. How is this taken into account?

ENTSO-E's answer: The system needs study looks at cross-border capacity increases without consideration for whether the increase in capacity comes from a new line or from the increased efficiency of an existing line(s) with smart technology. The identified need may be addressed by a wide range of solutions, including smart technologies. Solutions to identified needs are proposed by project promoters and may be assessed in the next phase of the TYNDP, project CBA.

Hybrid offshore networks will show value but fail in times of system stress.
See https://www.storelectric.com/offshore-energy-networks/

ENTSO-E's answer: Thank you for your opinion.

As a next step, is it possible to review the current capacity threshold of 225MW for PCIs? This will allow access to different storage technologies.

ENTSO-E's answer: The capacity threshold for a storage project to be eligible for PCI status is set in the TEN-E Regulation, which was revised in 2021. We suggest you address any comment to the responsible staff in the European Commission.

ENTSO-E: "We are not the body setting the agenda nor leading the review of Regulations". Regulations prevent the solutions the grids need, so they are 100% relevant.

ENTSO-E's answer: Regulation is definitely relevant, but any comments on EU regulation are better addressed to European lawmakers.

How is the investment candidate list developed and set?

ENTSO-E's answer: In respect of increases in cross-border capacity, ENTSO-E collected data (regarding capacity and costs) from project promoters of TYNDP 2020 projects in the fall of 2021. On borders where there were no or few existing planned investments, the collected data was completed using conceptual projects proposed by TSOs. The ultimate objective is to propose to the optimiser a list of investment candidates with realistic capacities and costs.

Cost assumptions include the CAPEX of the investment and the cost of any needed reinforcement of the internal transmission network.

As regards flexibility investments, the assumptions are based on data collected and consultation with TSOs within the scenario-building process. It is not broken down into distinct investments but takes the form of capacity in MW per market with associated costs.

Flexibility of Storage (Pump Hydro and Batteries): Is the long-term flexibility taken into account (daily, weekly and longer)?

ENTSO-E's answer: This is specified in the system-needs methodology report; please refer to pages 40 – 43.

How will isolated systems be treated in the model? And how is the value assigned to address the energy isolation of a country?

ENTSO-E's answer: The need to connect isolated systems is assessed like any other need. There is no special value assignment to the first capacity increase connecting an isolated country.

However, it is natural that the SEW achievable by any capacity increase is greater than that associated with subsequent increases (the SEW of a new project decreases with the already installed capacity). Consequently, there is indeed a greater value for the first capacity increase than for those that follow. This makes it more likely that investment candidates that would end the isolation of a previously isolated system would be selected for the optimal solution.

Why is flexibility only for peaking and storage, and where are other sources considered given the EC requirement to maximise the existing grid first?

ENTSO-E's answer: The inclusion of flexibilities in the 2022 system needs study is a pilot and represents a significant challenge for ENTSO-E's modelling experts and tools. That is why it was decided to limit the flexibilities to storage and peaking as a first step. If the 2022 study is successful, we will consider the inclusion of additional flexibilities in future editions of the study.

What if one interconnection candidate is selected by the optimiser in 2030 but not in 2040?

ENTSO-E's answer: It is normal that when looking at two different scenarios, two different optimal configurations are identified. The list of needs identified by the study constitutes an example of an optimal configuration, and changing the scenario or the investment candidates would likely generate different optimal configurations. The value of the system needs study is not to find one optimal solution but to show that there are margins for improvement.

The situation where investment candidates were part of the optimal solution in 2030 but not in 2040 happened in TYNDP 2020 on two borders, where the investment candidates did not show sufficient benefits in relation to costs to be selected for 2040. A deeper analysis revealed that the needs were selected in an "upper-bound" solution: the optimum was very flat, and, when broadening it to include needs that delivered just slightly lower overall benefits, these investments were included. This "upper-bound" solution can be found in Figures 1.4 and 1.5 of the 2020 system needs report, which shows that these investments were still valuable in 2040.

Will the 70% rule of the Clean Energy Package will be taken into account in determining maximum cross-border exchanges?

ENTSO-E's answer: The 2022 edition of the system needs study does not take into account the 70 % rule because ENTSO-E considers that there is currently insufficient maturity and alignment of views on how to implement the rule in our models. There are ongoing workstreams that include regulators and other actors, but no consensus has emerged so far.

Will the system needs study for 2022 TYNDP take all three scenarios into account? (NT, DE and GA) If so, will we see three different optimised power system configurations?

ENTSO-E's answer: The 2022 system needs study will be based on the National Trends scenario only.

Unlike National Trends, which is a scenario generated using TSO data, the Distributed Energy and Global Ambition scenarios are designed to meet the objective of climate neutrality in 2050. To build these, we run optimisation engines that model the scenarios based on this objective. Therefore, the Distributed Energy and Global Ambition scenarios can, in a way, be seen as system needs. This is the main reason why the system needs study is performed only for the National Trends scenario.

In the reports accompanying the release of the system needs study, we can consider how the identified system needs compare to the capacity increases in Distributed Energy and Global Ambition scenarios.

The National Trends scenario will quickly become redundant as countries expand their climate ambitions. Should the analysis be repeated for more ambitious scenarios?

ENTSO-E's answer: As countries increase their ambitions, the National Trends scenario in each successive TYNDP becomes more ambitious in turn. The National Trends scenario that will be assessed in the TYNDP 2022 system needs study is more ambitious than the same scenario in the TYNDP 2020 system needs study. We expect that, if repeated in TYNDP 2024, the needs study will consider a yet more ambitious scenario.

Will you publish the methodology for the selection of climate years?

ENTSO-E's answer: Yes, it will be published. It was developed as part of the locational marginal pricing study conducted as part of the second BZR. We expect that the methodology will be released by July 2022, but the exact timing requires ACER confirmation.

Are you also going to use the NTC model (as well as the zonal model) for 2030 to assess the impact of different weather years?

ENTSO-E's answer: Because of time constraints, it is not possible to run the 2030 study on an NTC model. However, we are investigating the operational feasibility of running the 2030 study for three climate years.

The answer to Zeid's questions was not clear. If the Italy-Tunisia project is not a PCI, is it ignored from the system needs calculation?

ENTSO-E's answer: Yes, the list of capacity increases proposed to the optimiser includes all existing projects from EU to non-EU countries, provided they have PCI status.

Do you consider SSSCs for digital power flow control as part of the flexibility solutions?

ENTSO-E's answer: The inclusion of flexibilities in the 2022 system needs study is a pilot and represents a significant challenge for ENTSO-E's modelling experts and tools. That is why it was decided to limit the flexibilities to storage and peaking as a first step. We might consider the inclusion of additional flexibilities in future editions of the study.

In TYNDP 2018, Tunisia was an endogenous zone, but this was not maintained in TYNDP 2020. Algeria and Morocco should also be an endogenous zone in the 2030 and 2040 studies, and Ukraine and Moldova should be included as an endogenous zone, considering the synchronisation pattern.

ENTSO-E's answer: Thank you for your comment.

Why will the 70% rule on cross-zonal capacity not be taken into account? Identified system needs may be overestimated as a result.

ENTSO-E's answer: The 2022 edition of the system needs study does not take into account the 70 % rule because ENTSO-E is of the view that currently, there is not sufficient maturity or alignment of views on how to implement this rule in our models. There are ongoing workstreams that include regulators and other actors, but no consensus has emerged so far.

It could be significant that ENTSO-E publishes all the data, including costs for candidates used for the planning option application of ANTARES.

ENTSO-E's answer: The list of investment candidates, including related capacities and cost assumptions, will be published.

Will the zonal clustering model be published in opendata to allow complementary research?

ENTSO-E's answer: Yes, it will. The clustering used in TYNDP 2020 is already published; the TYNDP 2022 zonal clustering will be released with the study in Q3 2022.

I disagree that the 2050 horizon is too difficult; 2050 is the date by which we need to decarbonise and 2030 (in just eight years) is an extrapolation of current plans. This is a totally different approach.

Thank you for your views. We agree that developing scenarios for 2050 is very different from doing so for 2030. As explained, ENTSO-E has considered the possibility of studying time horizons beyond 2040. The farther into the future the projection, the more uncertain the models become. The level of uncertainty in considering the 2050 horizon and beyond renders this study too expensive in terms of work to generate a proper representation of 2050.

RES and Hydro time series have a significant impact on this study. Will you consult them? 2040 RES time series were not published nor consulted in the previous system needs study.

ENTSO-E's answer: All main datasets will be published. Because of the mass of data, we do not systematically publish everything, but stakeholders are welcome to contact us if they are interested in obtaining data that is not published on our website.

It may happen that we cannot release data because either:

_ it is private data that we paid for, such as climate data;

_ the regulation prevents us from releasing some data, such as network models.

The market analysis is only SEW-based? Why?

ENTSO-E's answer: To analyse system needs for 2030 and 2040, ENTSO-E determined the combination of potential increases in cross-border network capacity and flexibilities that minimises the total system costs, composed of total investment (including costs of related necessary internal network reinforcements) and generation costs. A panel of possible network increases and flexibility solutions is proposed to an optimiser, who identifies the most cost-efficient combination. In TYNDP 2022, the identified system needs in 2040 also consider the contribution of potential capacity increases to alleviating security of supply issues.

The mutual influence of different investment opportunities is taken into account by performing the analysis simultaneously for all investments (transmission and flexibilities).

The identified needs are a depiction of the effective cross-border transfer capacity increases necessary for a cost-optimised and secure operation of the 2030 and 2040 systems.

It is important to note that considerations in terms of system resilience or other societal and environmental benefits are not included in the system needs analysis. They are, however, considered in the next step of the TYNDP, the CBA of projects, which considers a series of indicators, including the impact of each project on CO_2 and non-CO_2 emissions (nitrogen oxides, particulate matter) and reductions in energy not served.

How is the Location of possible flex solutions identified?

ENTSO-E's answer: The localisation of flexibility needs is identified based on the localisation of investment candidates proposed to the optimiser. For storage, those were based on the TYNDP 2022 list of storage projects.

However, the system needs study does not identify solutions. The methodology can only identify where, for example, market integration could be further improved. However, it does not identify which technology would be best to address the identified need. ENTSO-E believes that needs will be addressed by a combination of solutions to be proposed by project promoters. The solution(s) to a flexibility need may include increasing storage capacity, but also generation and a capacity increase on a neighbouring border.

Will future models consider the impact of rising temperatures on line capacity? More capacity may be needed just to overcome this limitation.

ENTSO-E's answer: ENTSO-E is now starting to work on the methodology for the 2024 system needs study. We will keep this idea in mind.

Thank you so much for this very meaningful interactive webinar. Well done!

ENTSO-E's answer: Thank you, we appreciate your feedback.

No-regret decisions can only be taken in the context of 2050 (not 2040) plans/scenarios; otherwise, solutions may become obsolete by decarbonisation.

ENTSO-E's answer: Thank you for your comment. The system needs study looks at 2040 and at 2030 because these are the time horizons currently being investigated in the PCI process run by the European Commission, which the TYNDP feeds into. ENTSO-E has considered the possibility of studying time horizons beyond 2040. The farther into the future the projection, the more uncertain the models become. The level of uncertainty which we would face for 2050 and beyond renders this study too expensive in terms of work to have a proper representation of 2050.

The general public should be consulted on all data and methodologies to ensure fair treatment (e.g. regarding storage), improve transparency, and avoid arbitrariness

ENTSO-E's answer: All data used in the system needs study, as well as its methodology, will be submitted alongside the TYNDP 2022 package for public consultation from July until September 2022.

Appendix 3 – Comments received in the public consultation on key improvements to the TYNDP 2022 Implementation Guideline and ENTSO-E's responses

Q1. The TNYDP 2022 specific Implementation Guidelines aim to complement the guidance given within the 3rd CBA Guideline by delivering the methodologies used to assess projects in the TNYDP 2022. It, therefore, gives additional information on models, tools, data, and examples, as well as additional case-specific explanations and clarifications. The aim is to deliver all the information needed to perform the project assessment.

Is this approach sufficient, and, if not, what do you think was missing in the previous edition of the Implementation Guidelines or needed additional explanation or clarification?

Anonymous

It would be great to

1) have the draft document; For now, I only have the following version:
https://eepublicdownloads.entsoe.eu/clean-documents/tyndp-documents/Cost%20Benefit%20Analysis/200128_3rd_CBA_Guideline_Draft.pdf

2) first, have a general introduction to the CBA methodology. This would be very useful for people new to the topic, in the form of a webinar.

3) subsequently, summarise the differences or improvements from the previous version in the form of a webinar.

ENTSO-E's answer:

1) ENTSO-E will consider publishing the whole guideline document for early consultation for the next TYNDP.

2) A short introduction and a link to the 3rd CBA Guideline are already given at the beginning of the Implementation Guidelines

3) A short overview of the main changes since the Implementation Guidelines for the TYNDP 2020 has been introduced in the document. For the next TYNDP, ENTSO-E will continue to work on improving the transparency of the process.

Yes.

Given that there is no space for general comments:

_ ENTSO-E should run public consultations on the data of third countries. So far, this data has not been considered, which means that ENTSO-E does not comply with article 11 (Annex V) of the regulation (EU) 347/2013. Data consulted should include installed capacities, interconnection capacities, hydro inflows, fuel prices, demand, RES profiles and technologies.

_ Market and network data should be published with an hourly resolution, with the base case and the cases with or without the project being assessed for all scenarios.

ENTSO-E's answer: ENTSO-E appreciates this positive feedback.

The consultation and publication of detailed modelling data are out of the scope of the Implementation Guidelines. Only the most fundamental information needed to perform the indicator-based CBA assessment is included.

currENT Europe

This incremental approach is safe and regulatorily sound but insufficient if the goal is to enable EU-wide decarbonisation of the energy system. There is a need to establish what is necessary to achieve economy-wide carbon neutrality in 2050 and work back from there, planning and designing a transition to a fit-for-purpose grid infrastructure.

Therefore, the CBA needs to be based on scenarios that ensure the net-zero scenarios are reached.

We have not seen the 2022 Implementation Guidelines; however, the 2020 guidelines failed to address the following issues: flexibility, the complementarity of solutions, redeployability, scalability, fast deployment, and modularity.

ENTSO-E's answer: This question was intended to address the process and the link between the CBA Guideline and its application in the TYNDP. However, we appreciate this feedback on the missing parts, which are more related to the overall TNYDP and scenario building, especially the listed issues, and which ENTSO-E is always working to improve.

EDF SA

EDF welcomes these Implementation Guidelines as a valuable and helpful tool to help project promoters implement the CBA methodology developed by ENTSO-E to assess their infrastructure projects or help understand how ENTSO-E proceeds. However, in principle, it is not the role of implementation guidelines to further enrich or propose additional indicators to the methodology. The Implementation Guidelines can indeed help identify necessary improvements but should be limited to their primary role. EDF is of the view that a separate process for the evolution of the methodology should be favoured.

ENTSO-E's answer: The structure of the 3rd CBA Guideline follows a general and modular approach. It explicitly refers to and relies on the study-specific implementation guideline:

a. It is modular as each individual indicator or aspect within the 3rd CBA Guideline is presented as an individual module. This approach would allow ENTSO-E to include small changes or revise / add / revoke single indicators in a clearer manner without changing the entire document.

b. It is more general since very specific details or assumptions needed for applying the CBA Guidelines are dealt with in the Implementation Guidelines, while the CBA relies on the main concepts.

Smart Wires

The CBA needs to be based on scenarios that ensure that net-zero scenarios are reached.

We have not seen the 2022 Implementation Guidelines; however, the 2020 guidelines failed to address the following issues: flexibility, redeployability, scalability, fast deployment, modularity, and complementarity of solutions in a toolbox.

ENTSO-E's answer: This question was intended to address the process and the link between the CBA Guideline and its application in the TYNDP. However, we appreciate this feedback on the missing parts, which are more related to the overall TNYDP and scenario building, especially the listed issues, and which ENTSO-E is always working to improve.

SuperNode Ltd

This incremental approach is safe and regulatorily sound but insufficient if the goal is to enable EU-wide decarbonisation of Europe's energy system.

There is a strong need to establish what is necessary for economy-wide carbon neutrality in 2050 and work back from there, planning and designing a transition to a fit-for-purpose grid infrastructure. Therefore the CBA needs to be based on scenarios that ensure the net-zero scenarios are reached.

The 2020 Implementation Guidelines failed to address the following issues which should be included in the new guidelines: flexibility, the complementarity of solutions, redeployability, scalability, fast deployment, and modularity.

ENTSO-E's answer: This question was intended to address the process and the link between the CBA Guideline and its application in the TYNDP. However, we appreciate this feedback on the missing parts, which are more related to the overall TYNDP and scenario building, especially the listed issues, and which ENTSO-E is always working to improve.

Q2. Indicator B6 – SoS – Adequacy: In order to assess the Security of Supply (which is associated with very scarce phenomena) with sufficient accuracy, ENTSO-E currently uses all the PECD climate years of the database combined with 15 randomised yearly availabilities of thermal power plants resulting in 510 Monte-Carlo Years.

Do you consider this approach sufficient to represent the variety of offer and supply balance situations?

Anonymous

I do not have the expertise necessary to challenge this methodology; it seems like a great approach.

ENTSO-E's answer: ENTSO-E appreciates this positive feedback.

It is not clear if the power plant granularity should be per unit or aggregated (average size). The number of outages needed to have a consistent CBA depends on this detail. The number of Monte-Carlo years could be fine, but so far seems arbitrary.

ENTSO-E's answer: Additional information on the creation of the Monte-Carlo years has been introduced to the Implementation Guidelines.

currENT Europe

This is appropriate.

ENTSO-E's answer: ENTSO-E appreciates this positive feedback.

EDF

When assessing adequacy, it seems important to have a sufficient number of climate years to properly represent the climate events and assess the thermal capacities needed. As it stands, ENTSO-E fails to justify the reason for choosing 15 randomised yearly availabilities of thermal power plants, making it difficult for market participants to express an informed view on the accuracy of this approach. EDF calls on TSOs to provide evidence of the fact that such a number of randomised yearly availabilities of thermal power plants consists in a better trade-off between precision and computational complexity.

Considering fewer Monte-Carlo years can lead to an underestimation of the high variability of the climatic conditions (renewable production, thermal sensitivity) and their impact.

EDF also wonders whether, and to what extent, climate change is modelled in the PECD climate years.

ENTSO-E's answer: Additional information on the creation of the Monte-Carlo years has been introduced to the Implementation Guidelines. For future TYNDPs, we will consider to what extent the PECD can be updated in order to cope with the effects of climate change.

SuperNode Ltd

Yes.

ENTSO-E's answer: ENTSO-E appreciates this positive feedback.

Q3. Indicator B6 – SoS – Adequacy: In order to monetise the Energy not Supply avoided, thanks to a new project, for each country, ENTSO-E is going to use the value of lost load each has developed in compliance with the Clean Energy Package (article 11.1). For those countries where the value of lost load has not been computed yet, ENTSO-E intends to use 10 k€/MWh, a value in the order of magnitude of what is currently taken into account and that has been used by ENTSO-E in previous TYNDP.

Do you agree with this choice?

Anonymous

This choice is great; no remarks.

ENTSO-E's answer: ENTSO-E appreciates this positive feedback.

Yes.

ENTSO-E's answer: ENTSO-E appreciates this positive feedback.

currENT Europe

This is appropriate and needs to be reasonably high to provide adequate investment signals.

ENTSO-E's answer: ENTSO-E appreciates this positive feedback.

EDF

EDF understands that, for practical reasons, ENTSO-E proposes some values for the VoLL for those countries where it has not been computed yet but calls for caution in the use of an absolute value.

ENTSO-E's answer: In future, Member States shall compute these values according to regulation (EU) 2019/943 article 25 nº 1) when applying capacity mechanisms, Member States shall have a reliability standard in place. A reliability standard shall indicate the necessary level of security of supply of the Member State in a transparent manner and in nº 3). The reliability standard shall be calculated using at least the value of lost load and the cost of new entry over a given timeframe and shall be expressed as "expected energy not served" and "loss of load expectation".

Smart Wires

Yes, this is adequate as it provides sufficient incentive to invest.

ENTSO-E's answer: ENTSO-E appreciates this positive feedback.

SuperNode Ltd

Yes. A high price is needed to provide a strong investment signal.

ENTSO-E's answer: ENTSO-E appreciates this positive feedback.

Q4 Indicator B6 – SoS – Adequacy: In order to monetise avoided investment for peaking power plant avoided thanks to a new project, ENTSO-E intends to use, for each country, the cost of new entry assessed by each country through the ENTSO-E methodology (link here). For those countries where the cost of new entry has not yet been computed, ENTSO-E intends to use 42 k€/MW/year, a value in the order of magnitude of what is currently taken into account, and that has been used by ENTSO-E in previous TYNDP and in the scenario-building phase.

Do you agree with this choice?

Anonymous

The link does not seem to work – I would be very interested in the methodology and assumptions used to compute this number. I would guess that this parameter would be about 20 % higher based on the projects my company is looking at.

ENTSO-E's answer: Acknowledged.

The value used should correspond to the minimum value between an OCGT and an oil power plant.

ENTSO-E's answer: In cases where no country-specific data is available, the current assumption is that the price-determining power plants are OCGT.

currENT Europe

This is appropriate and needs to be reasonably high to provide adequate investment signals.

We also believe that it needs to be recognised that interconnectors can also contribute to the provision of adequacy and should be included in the analysis.

ENTSO-E's answer: ENTSO-E appreciates this positive feedback.

The contribution of interconnectors to adequacy provision should also already be considered in the CBA phase, in the B6 indicator.

EDF

EDF understands that, for practical reasons, ENTSO-E proposes some values for the cost of new entry for those countries where it has not been computed yet but calls for caution in the use of an absolute value.

ENTSO-E's answer: In future, Member States will compute this value according to regulation (EU) 2019/943 article 25 nº 1: when applying capacity mechanisms, Member States shall have a reliability standard in place. A reliability standard shall indicate the necessary level of security of supply of the Member State in a transparent manner, and, in nº 3: the reliability standard shall be calculated using at least the value of lost load and the cost of new entry over a given timeframe and shall be expressed as "expected energy not served" and "loss of load expectation".

Smart Wires

Yes, agreed, but it needs to be recognised that interconnectors can also contribute to the provision of adequacy and should be included in the analysis.

ENTSO-E's answer: ENTSO-E appreciates this positive feedback. The contribution of interconnectors to adequacy provision should already be considered in the CBA phase, in the B6 indicator.

SuperNode Ltd

Yes. A high price is needed to provide a strong investment signal. In addition, it should be recognised that interconnectors can also contribute to ensuring adequacy and should be included in the analysis.

ENTSO-E's answer: ENTSO-E appreciates this positive feedback.

The contribution of interconnectors to adequacy provision should also already be considered in the CBA phase, in the B6 indicator.

Q5. Project-Level Indicators: in relation to the "non-mature" indicators (B7, B8) and the redispatch calculations and based on the content of the previous editions of the Implementation Guidelines (where those were addressed as "project-level indicators"), **where do you think that additional clarity should be delivered in terms of calculation?**

Anonymous

I would be very interested in the reasons why these indicators cannot be monetised, at least partially. This is really not clear to me. It seems to me that there are published studies that took these elements into account in various ways. I would need an additional explanation on this point.

A document and a webinar on this topic would be great.

ENTSO-E's answer: ENTSO-E has already organised a meeting in the past, and for the development of the 3rd CBA Guideline, the public was also invited to directly work with ENTSO-E on these indicators. It turned out that currently, there seems to be no methodology applicable to the TYNDP process. Of course, there are detailed studies published, but for the CBA and within the framework of the TYNDP, we need to consider resources and a tight deadline. Complex and detailed studies in SoS cannot be incorporated into this process. On the other side, simplified indicators seem not to be applicable either, as they are lacking in important details.

However, ENTSO-E is always working to improve this shortcoming of the CBA Guideline, and welcomes any constructive suggestions.

Due to its complexity, it should not be a project-level indicator, but an indicator computed in a transparent way by ENTSO-E.

ENTSO-E's answer: ENTSO-E, in principle, agrees on that statement, but within the frame of the TYNDP, this is currently not possible.

currENT Europe

B7 – Flexibility characterises the impact of the project on the ability to exchange balancing energy in the context of high penetration levels of non-dispatchable electricity generation. Balancing energy refers to products such as Replacement Reserve (RR), mFRR, and aFRR. Exchanging/sharing balancing capacity (i. e., RR, mFRR and aFRR) that requires guaranteed or reserved cross-zonal capacity is also taken into account.

B8 – Stability characterises the project's impact on the ability of a power system to provide a secure supply of electricity. B8.0 Qualitative stability indicator; B8.1 Frequency stability; B8.2 Blackstart services; and B8.3 Voltage/reactive power services.

ENTSO-E's answer: ENTSO-E appreciates this feedback and will consider this for the next update.

SmartWires

The additional clarity in terms of their calculation could be provided as a guidance note from ENTSO-E with ACER/EC support. However, the ability of the TYNDP to calculate this is limited until a dynamic model of the synchronous systems is available. Therefore, the calculation, at least for cross-border or transmission-to-distribution interfaces, should be calculated on the basis of the increased capacity, the latency in this capacity for energy trade, that is, the spare capacity not being used at a point in time to trade energy and that can be reused to provide reserves. Note the reserves being shared between jurisdictions would, of course, need to exist at that time in country B to support country A.

For the B8 indicator, the ability to improve the stability margin on a circuit network should be recognised since technology with this ability can support stability, frequency B8.1 (increasing transient stability margin), voltage 8.3 (directly providing reactive voltage injection), and 8.2 (by reducing the need for black start units and/or making existing units reach further across the network).

ENTSO-E's answer: ENTSO-E appreciates this feedback and will consider this for the next update.

Q6. Scenarios: Three climate years, 1995, 2008, and 2009 have been selected using a methodology based on the year's representativeness of the climate years within the Pan-European Climate Database. The results from market simulations are then considered based on the weighted average from these three climate years. The weighting is as follows: 0.233 for 1995, 0.367 for 2008 and 0.4 for 2009.

Do you see this approach and the number and choice of the climate years as sufficient? If not, which climate years should be used and why?

Anonymous

I do not have sufficient expertise to challenge this choice; it seems OK to me.

ENTSO-E's answer: ENTSO-E appreciates this positive feedback.

ENTSO-E has not published the assumptions behind PECD, so it is not possible to say if these are the right years.

ENTSO-E's answer: Information about the PECD can be found in Section 6.3 in the ERAA report, found under the link here. Further information and assumptions on how the climate years are chosen for the TYNDP can be found in Section 4.1 and appendix VII in the Scenario Building Guidelines, found here.

currENT Europe

Using a larger number of years seems likely to deliver more robust results, and the most recent available climate years should be considered.

ENTSO-E's answer: ETNSO-E believes that three years is a good compromise between robust results and computation time. The choice of the three climate years is based on BZR methodology: the most recent climate years are not better than the oldest, but ENTSO-E will further investigate improving this process for subsequent TNYDPs.

EDF

Although selecting climate years according to their representativeness out of the climate years within the Pan-European Climate Database seems to be the optimal way for the optimisation, EDF deeply regrets the lack of transparency (i) on the methodology used for both the selection and the weighting and (ii) on the number of selected years.

Besides, EDF wonders whether ENTSO-E is already planning to consider an increased number of climate years in the next CBA.

ENTSO-E's answer: The choice of the three climate years is based on the BZR methodology.

Within the TYNDP 2022, ENTSO-E will not change the number of climate years. But for the TYNDP 2024, ENTSO-E will assess the realisation of increasing the number.

Smart Wires

The climate years do not show enough variation in the temperature, solar and wind variance across the grid.

This method does not account for increasing more likely extreme weather events in future years, nor does it give the full range of weather variations to be endured. A long drought, for example, would drive a major cost in one year for certain regions that would need to be paid and should be included in a CBA for a project. This regional situation is at risk and most likely will be lost by trying to find a representative year for Europe.

In addition to the method proposed, each individual full year should be analysed regionally, looking for these hidden trends and then using the outcome of the analysis to make adjustments for these with weighted factors, but still enable the TYNDP to be run at a Pan-European scale.

ENTSO-E's answer: ENTSO-E believes that three years is a good compromise between robust results and computation time. The choice of the three climate years is based on BZR methodology: the most recent climate years are not better than the oldest, but ENTSO-E will further investigate improving this process for the following TNYDPs.

SuperNode Ltd

A larger number of years is likely to deliver more robust results, and the most recent available climate years should be considered.

ENTSO-E's answer: ENTSO-E believes that three years is a good compromise between robust results and computation time. The choice of the three climate years is based on BZR methodology: the most recent climate years are not better than the oldest, but ENTSO-E will further investigate improving this process for the following TNYDPs.

TIWAG-Tiroler Wasserkraft AG

The selection of three weather years seems to be too few as a proxy for the representation of the weather situation of 35 years (at least 10 weather years).

A comprehensive and transparent description of the selection process is needed.

If only a few weather years are used, tend to use "more recent" years (the weather of the last decade is not appropriately taken into account; moreover, the climate has changed significantly since 1995 (temperature, precipitation, extreme events); in 2012, for example, there was a pronounced cold spell)

ENTSO-E's answer: ENTSO-E believes that three years is a good compromise between robust results and computation time. The choice of the three climate years is based on BZR methodology: the most recent climate years are not better than the oldest, but ENTSO-E will further investigate improving this process for subsequent TYNDPs.

Q7. Scenarios: In the TYNDP 2022, the plan is to perform the CBA assessment for each of the three climate years for the time horizons 2030 and 2040 and with each applied to different scenarios.

Do you consider these time horizons relevant for the TYNDP 2022 CBA assessment, and do they provide a sufficient overview of the benefits of the projects? If not, which ones should be considered?

Anonymous

Yes, they are relevant and sufficient.

ENTSO-E's answer: ENTSO-E appreciates this positive feedback.

2050 is also relevant due to the Paris agreement.

ENTSO-E's answer: ENTSO-E appreciates this constructive feedback and will take this proposal under consideration for the next TNYDPs. However, in terms of economic evaluation (calculation of the net present value), 30 years of distance will have little impact on results.

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currENT Europe

The 2050 horizon should be considered. Meeting the 2050 goals will require significant additional effort. Given that transmission investments are typically long-term in nature, it makes sense to evaluate projects in terms of their contributions to longer-term goals as well as with reference to the 2030 and 2040 time horizons.

ENTSO-E's answer: ENTSO-E appreciates this constructive feedback and will take this proposal under consideration for the next TNYDPs. However, in terms of economic evaluation (calculation of the net present value), 30 years of distance will have little impact on results.

EDF SA

Keeping consistent time horizons between the TYNDP and the CBA assessment makes sense. While acknowledging that a distant time horizon comes with a high level of uncertainty, EDF wonders whether the CBA assessment could also be performed for 2050 – since the power sector may meet major challenges in this time frame, especially when it comes to the decarbonisation goals.

ENTSO-E's answer: ENTSO-E appreciates this constructive feedback and will take this proposal under consideration for the next TYNDPs. However, in terms of economic evaluation (calculation of the net present value), 30 years of distance will have little impact on results.

Smart Wires

4 They are relevant, but near-term time horizons should also be considered, such as 2023 and 2025.

ENTSO-E's answer: This is not the aim of the TYNDP, which is more related to mid-term and long-term effects than the very short-term aspects. Please also consider the investigation in the adequacy studies (e. g., ERAA)

SuperNode Ltd

2050 should be considered. Meeting the 2050 goals will require significant additional effort. Given that transmission investments are typically long-term in nature, it makes sense to evaluate projects in terms of their contributions to longer-term goals as well as with reference to the 2030 and 2040 time horizons.

ENTSO-E's answer: ENTSO-E appreciates this constructive feedback and will take this proposal under consideration for the next TNYDPs. However, in terms of economic evaluation (calculation of the net present value), a 30-year distance will have little impact on results.

TIWAG-Tiroler Wasserkraft AG

Regarding the selection of reference years, see our response to question No. 9.

Q8. Reference Grid: Based on the guidance given within the 3rd CBA Guidelines, for the TYNDP 2022, two different reference grids are defined for the corresponding horizons, 2030 and 2040. The reference grids for the 2030 and 2040 horizons are based on the maturity criteria as set out in the 3rd CBA Guideline.

Additionally, in respect of the above maturity criteria, a cut-off for the commissioning years has been set. This choice deals with uncertainties in the planning and construction, ensuring that only projects having a strong chance of being commissioned at the dates of the respective scenarios are part of the reference grid. The cut-off has been set to 31 December 2027 for the mid-term horizon (2030) and 31 December 2035 for the long-term horizon (2040), excluding all projects with planned commissioning dates later than these cut-offs.

Do you agree with defining distinct cut-off years to take due account of possible uncertainty?

Anonymous

Yes, I have no reasons to challenge this choice.

ENTSO-E's answer: ENTSO-E appreciates this positive feedback.

Anonymous

Yes, but the question is how a project substantiates that it will be commissioned before a given cut-off date. So far, CBA Guidelines leave the door open for TSOs to take arbitrary decisions. Entities like regulators without conflicts of interest should be in charge of assessing the commissioning dates of projects.

ENTSO-E's answer: The CBA Guideline, on which the Implementation Guidelines are based, explicitly mentions that the commissioning years need to be in line with the information given in the respective national development plans, or they need to be agreed with the respective regulator.

currENT Europe

The 2050, 2040 and 2030 target reference grids should be included in the assessment of benefits for new projects to close the gap between what already exists and what we need. This will allow hybrid projects to be more fully assessed. The risk of stranded assets is less than the risk of failing to decarbonise.

If the reference grid is based on today's grids plus those additional projects that we feel will make it through current planning processes, the result will be a small, inefficient grid that will not meet the 2050 decarbonisation pathway.

The reference grid for 2040 must reflect what is needed to reach European economy-wide decarbonisation in 2050. For the electricity sector, that would require full decarbonisation well before 2040. In addition, the infrastructure must be able to support the decarbonisation through electrification of the heating, transport, and industrial sectors.

Grid-enhancing technologies that are mature and available today, and other technologies that are expected to mature in near years, can significantly improve the efficiency of grids, affecting both the willingness to invest in new grids and the questions of when and where to invest in what kind of grid components. The future reference grid must assume the use of existing and expected technologies when it is socio-economically beneficial to do so.

ENTSO-E's answer: ENTSO-E appreciates this constructive feedback, although it exceeds the frame of this question. To be noted: the choice of the reference grid for modelling purposes, as in the TYNDP, does not, in any event, impact the realisation of future projects.

EDF SA

EDF is of the view that it makes sense to have in the reference grids, at longer time horizons only, those projects having a strong chance of being commissioned and welcomes the idea of improving the CBA by also taking into account this commissioning horizon dimension, especially considering the delays that can be observed and that ACER notably points out in its PCI annual report.

Yet, EDF regrets the lack of transparency in the way those dates have been calculated, and wonders whether the methodology used could be shared with market participants so they can replicate the calculations.

ENTSO-E's answer: No calculations have been performed to establish these cut-off dates. They were chosen to take into account the possible delays of projects.

Smart Wires

We believe that an approach focusing only on PCIs that are in construction or in permitting or planning stages is too narrow. Such an approach does not consider any optimisation projects whose lead time can be from 1– 5 years.

Taking optimisation into account helps as it gives lead times to new projects to be delivered.

We suggest having an average/typical development to commissioning time for each category/type of technology. This should be consulted with stakeholders. These would allow the TYNDP process to assess whether to use the existing 3rd CBA Guideline, which is based on whether there is sufficient certainty in the timelines to consider whether a new project could be built and therefore make it into the reference case. For long-lead-time technologies like circuits, this seems reasonable, but for shorter lead-time technologies like optimisation technologies, it may only take a couple of years to move from analysis to construction. A stakeholder-consulted lead time for optimisation and capital projects based on European lead-time example projects would provide sufficient evidence to make this distinction.

ENTSO-E's answer: The reference grid is not composed of PCI projects only but also includes projects submitted to the TYNDP that fulfil the reference grid criteria. ENTSO-E appreciates this constructive feedback, although it exceeds the frame of this question. To be noted: the choice of the reference grid for modelling purposes – as in the TYNDP – does not, in any event, impact the realisation of future projects.

SuperNode Ltd

The 2050, 2040, and 2030 target reference grids should be included in the assessment of benefits for new projects to close the GAP between what already exists and what we need. This will allow hybrid projects to be more fully assessed. The risk of stranded assets is less than the risk of failing to decarbonise.

If the reference grid is based on today's grids plus those additional projects that we feel will make it through current planning processes, the result will be a small, inefficient grid that will not meet the 2050 decarbonisation pathway.

The reference grid for 2040 must reflect what is needed to reach European economy-wide decarbonisation in 2050. For the electricity sector, that would require full decarbonisation well before 2040. In addition, the infrastructure must be able to support the decarbonisation through electrification of the heating, transport and industrial sectors.

Grid-enhancing technologies that are mature and available today, and other technologies that are expected to mature in the coming years, such as transmission technology based on superconductors, can significantly improve the efficiency of grids, affecting both the willingness to invest in new grids and the questions of when and where to invest in what kind of grid components. The future reference grid must assume the use of existing and emerging technologies within the 2050 timeframe when it is socio-economically beneficial to do so.

ENTSO-E's answer: ENTSO-E appreciates this constructive feedback, although it exceeds the frame of this question. To be noted: the choice of the reference grid for modelling purposes, as in the TYNDP, does not, in any event, impact the realisation of future projects.

Q9. Modelling: Within the TYNDP CBA Implementation Guidelines, two options are allowed for the load-flow calculations. These are AC and DC-based load-flow calculations. Internal tests have shown that the line loadings and resulting losses – as needed to determine the B5 indicator – are well aligned between both approaches. Therefore, this comparison of AC and DC does not suggest any reasons to reject one modelling approach for another.

ENTSO-E believes that both the AC and the DC calculations are well suited for the CBA assessment. Do you agree?

Anonymous

I do not have sufficient expertise to challenge this choice; it seems OK to me.

ENTSO-E's answer: ENTSO-E appreciates this positive feedback.

Yes.

ENTSO-E's answer: ENTSO-E appreciates this positive feedback.

currENT Europe

Yes.

ENTSO-E's answer: ENTSO-E appreciates this positive feedback.

EDF SA

EDF welcomes the ENTSO-E approach to finding the best way to approximate network losses by analysing various load-flow calculations. In our understanding, DC-based load-flow calculations require more assumptions than AC calculations to estimate the network losses. Consequently, EDF would recommend opting for AC modelling.

ENTSO-E's answer: ENTSO-E appreciates this feedback.

Smart Wires

AC modelling allows for a more detailed assessment of network performance. It is important to assess long-term losses, which can help arbitrate between alternative technology solutions. The eco-design and energy efficiency directives focus precisely on the need to reduce losses in networks over time to reach the decarbonisation target.

ENTSO-E's answer: ENTSO-E appreciates this feedback.

SuperNode Ltd

Yes.

ENTSO-E's answer: ENTSO-E appreciates this positive feedback.

Q10. Modelling: The redispatch calculations, as in the TNYDP 2020, will again be treated as project-level indicators (indicators delivered by the project promoters). Do you see this as a reasonable approach also for future editions of the TNYDP, or **do you think ENTSO-E should invest additional resources, if needed, even on the cost of other processes, to make ENTSO-E centralised redispatch calculations available?**

Anonymous

I do not think that having project-level indicators is a good choice.

Based on my understanding of the methodology, I think that the methodology is great for evaluating investments in transmission lines but not well suited to evaluating investments in storage or other technologies that are capable of providing ancillary services.

I am firmly convinced that SEW calculations should be performed in a way that the demand for both energy and ancillary services (FRC, aFRR, mFRR) is satisfied. I would appreciate a detailed methodological explanation of why this is not the case already (I am convinced that this is technically feasible).

ENTSO-E's answer: ENTSO-E acknowledges that PLIs are not seen as a perfect solution and will further investigate possible solutions to make them general indicators as well. The second part seems to be out of the scope of this question.

No. ENTSO-E should calculate them.

ENTSO-E's answer: ENTSO-E will further investigate possible solutions for calculating redispatch on a centralised level.

currENT Europe

We believe that ENTSO-E needs to come up with a centralised analysis and calculation of redispatch. As a prime component of the SEW benefit indicator, the required redispatch is a very important indicator of the performance of power systems and should therefore be established centrally and independently.

ENTSO-E's answer: ENTSO-E acknowledges that redispatch calculations are seen as important and will further investigate possible solutions for calculating redispatch on a centralised level.

EDF SA

Project promoters are best placed to assess their dispatch costs but using their hypotheses may generate – in our view – two major risks. First, project promoters may use various calculation methodologies, leading to potentially biased comparisons between projects. Second, their calculations may be based on too optimistic hypotheses, especially when it comes to the commissioning date of the projects.

EDF wonders whether ENTSO-E is willing to put in place some safeguards to mitigate these risks.

ENTSO-E's answer: During the TYNDP 2020 process, when project promoters submitted redispatch calculations, they had to prove their compliance with a dedicated simplified test case. Further, within the Implementation Guidelines, detailed instructions on data and parameters were introduced. For this, TYNDP ENTSO-E is following the same approach, which should mitigate the risk of inconsistencies.

Smart Wires

We believe that ENTSO-E needs to come up with a centralised calculation of redispatch: the needed RD is a very important indicator for the performance of power systems and should therefore be established centrally.

Redispatch should first, systematically, and as a matter of principle, be addressed through optimisation of existing grids, and only then more lines-applying what is called in Germany, for instance, the NOVA principle (optimisation ahead of reinforcement ahead of more lines), and that project promoters are at risk of double counting the savings between projects. This is because the promoter models will not take into account other PCI applications that are expected to be commissioned earlier and that have the potential to reduce or eliminate the redispatch costs now.

ENTSO-E's answer: ENTSO-E acknowledges that redispatch calculations are seen as important and will further investigate possible solutions for calculating redispatch on a centralised level. We further appreciate this constructive feedback and will assess the proposal for the next TYNDP.

SuperNode Ltd

ENTSO-E should, in consultation with relevant stakeholders, develop a centralised analysis and calculation of redispatch. As a prime component of the SEW benefit indicator, the required redispatch is a very important indicator of the performance of power systems and should, therefore, be established centrally and independently.

ENTSO-E's answer: ENTSO-E acknowledges that redispatch calculations are seen as important and will further investigate possible solutions for calculating redispatch on a centralised level.

Q11. Hybrid project: As regards the assessment of projects aimed at both interconnection between countries/bidding zones and integration of generation (projects often called hybrid projects and mainly used for offshore hybrid projects), – **do you agree on restricting the modelling on the application of OBZ only, or do you think that HMs should also be allowed?**

Anonymous

It would be great to include also HMs.

ENTSO-E's answer: Acknowledged.

HMs should also be allowed.

ENTSO-E's answer: Acknowledged.

currENT Europe

The HM concept is today commonly used for radial connections of Offshore Wind Farms (OWFs) and offshore wind hubs to shore. The market design solution for offshore interconnectors is also well established and does not distinguish market-wise if they are built on land or subsea. The discussion of whether to apply the HM or OBZ concept applies to hybrid projects and multi-terminal configurations, where OWFs are connected to infrastructure that connects two or more bidding zones. Both concepts have pros and cons and require further analysis in several respects.

Based on current insights, the OBZ concept appears to be the prominent solution when considering the efficiency of markets and system operations, mainly as the OBZ concept provides a market solution that better reflects physical congestions and physical flows. The OBZ concept does, however, provide less market revenue to OWFs compared to the HM concept. Thus, the OBZ concept may affect price-setting in the offshore renewable energy tenders to realise investments in socio-economic efficient hybrid projects.

currENT strongly supports an approach to modelling the OBZs as a priority.

ENTSO-E's answer: ENTSO-E appreciates this comment and background information.

EDF SA

Hybrid projects are one of the issues addressed with a view to improving the CBA methodology and should, therefore, not be dealt with in an implementation guideline. Beyond this question, EDF considers that no decision has yet been made on the status of hybrid projects at the EU level. Therefore, modelling should remain open to both approaches (OBZ or HMs).

ENTSO-E's answer: The idea is to include such new methodologies within the Implementation Guidelines as test cases. After positive application in the TYNDP, such new methodologies could be transferred into the CBA Guideline.

Smart Wires

The OBZ price should not be determined by the best HM market price, and the transfer flows from one HM to another or from the generation itself – that is, a higher market price? Also, how are ancillary services being accounted for; can OBZ provide benefits in all HMs at the same time?

ENTSO-E's answer: This seems to be a misunderstanding; the question was whether to allow – just for modelling purposes – that the hybrid projects be modelled within an own newly defined OBZ or within the HM of one of the participating countries.

SuperNode Ltd

An approach to modelling the OBZs is a priority. The HM concept is today commonly used for radial connections of OWFs and offshore wind hubs to shore. The market design solution for offshore interconnectors is also well established and does not distinguish market-wise if they are built on land or subsea.

The discussion of whether to apply the HM or OBZ concept applies to hybrid projects and multi-terminal configurations, where OWFs are connected to infrastructure that connects two or more bidding zones. Both concepts have pros and cons and require further analysis in several respects.

Based on current insights, the OBZ concept appears to be the prominent solution when considering the efficiency of markets and system operations, mainly as the OBZ concept provides a market solution that better reflects physical congestions and physical flows. The OBZ concept does, however, provide less market revenue to OWFs compared to the HM concept. Thus, the OBZ concept may affect price-setting in the offshore renewable energy tenders to realise investments in socio-economic efficient hybrid projects.

ENTSO-E's answer: ENTSO-E appreciates this comment and background information.

Q12. Hybrid projects: **Should projects aimed at both interconnection between countries/ bidding zones and integration of generation (projects often called hybrid projects and mainly used for offshore hybrid projects) be assessed as "enablers" for the achievement of specific goals, such as a distinct amount of RES installed within the EU?**

Anonymous

This should be the case only if there is some indication from a reputable study that hybrid projects contribute significantly to an optimal European energy mix. I am not aware of such a study; I would appreciate a reference.

ENTSO-E's answer: Acknowledged and the comment will be considered when further updating the methodology.

Both numbers should be computed. With generation and without the additional generation. Then decision-makers can see what to do and how to compare projects.

ENTSO-E's answer: Acknowledged and the comment will be considered when further updating the methodology.

currENT Europe

Yes, and assessed in the context of a plan for the Pan-European grid infrastructure needed to move remotely based solar and wind to the centres of demand. This needs to be in line with the Renewables Directive update (article 7) on cooperation mechanisms.

ENTSO-E's answer: Acknowledged and the comment will be considered when further updating the methodology. We thank you for the additional information.

EDF SA

Here again, hybrid projects are one of the issues addressed with a view to improving the CBA methodology and should therefore not be dealt with in an implementation guideline.

Besides, the proposal here looks like introducing an additional indicator that is not technologically neutral to favour the RES objective. There is already indicator B2 in the methodology to assess the contribution of the projects to the EU climate or decarbonisation objectives.

ENTSO-E's answer: The idea is to include such new methodologies within the Implementation Guidelines as test cases. After positive application in the TYNDP, such new methodologies could be transferred into the CBA Guideline.

The B2 indicator only assesses the impact of the project on CO_2 emissions. The question here was if such hybrid projects should be treated as "enablers" for additional RES installation - on top of the scenario numbers

Smart Wires

Projects should be looking to deliver the maximum benefits to the end consumer and not focus on solving a single issue.

Agreed. They should be treated as enablers if the risk of double counting is recognised and avoided. For example, you cannot use a project to hit the 70 % target exporting energy at any time while being fully utilised for the import of renewables in the TYNDP network modelling.

We also believe that the following question requires further thought: Does the 15 % interconnection target for any country with its neighbours include the offshore network? If so, how is this offshore network apportioned?

We believe that this could only be effective at an indisputable point, for example, the shoreline with each jurisdiction and not an arbitrary point offshore, and its capacity must also be limited to the weakest link in the interconnection pathway, like onshore NTC calculations.

ENTSO-E's answer: Acknowledged and the comment will be considered when further updating the methodology. We thank you for the additional information.

SuperNode Ltd

Yes, and assessed in the context of a plan for the Pan-European grid infrastructure needed to move remotely based solar and wind to the centres of demand.

ENTSO-E's answer: Acknowledged and the comment will be considered when further updating the methodology. We thank you for the additional information.

Q13. Hybrid projects: considering the point raised in the previous question (and the answer given), **should it be permitted to assess those projects by adding RES capacity to the scenario numbers (PINT) or by reducing the scenario numbers because of the project (TOOT)?**

Anonymous

Same answer as for the previous question. I would like to see a METIS-type study that proves that this type of project is part of the optimal energy mix. This is a general remark – it would be good to consider only projects that fall within the optimal energy mix that has been identified in a public METIS-type study.

ENTSO-E's answer: Acknowledged and the comment will be considered when further updating the methodology.

None of them. The capacity should be reallocated accordingly. Scenarios are an equilibrium between supply and demand. Hybrid projects should just affect the location of the supply.

ENTSO-E's answer: Acknowledged and the comment will be considered when further updating the methodology.

currENT Europe

Adopting the TOOT (take one out at a time) approach implies a stronger network; thus, it tends to underestimate the impact of a project on the system. The PINT (put in one at a time) approach implies a weaker network and thus tends to overestimate the impacts.

ENTSO-E's answer: The question was if the scenario numbers should be adjusted based on the project's RES capacities (additional RES for PINT or reduced RES for TOOT)?

EDF SA

This methodological issue is not in the scope of implementation guidelines. EDF supports the use of both the TOOT approach (removing one project at a time) and the incremental approach (PINT – adding one project at a time) in order to provide confidence in the robustness of the indicators for all projects.

ENTSO-E's answer: The question was if the scenario numbers should be adjusted based on the project's RES capacities (additional RES for PINT or reduced RES for TOOT)?

Smart Wires

PINT should be considered for radial or an early delivered project, for example, pre-2025 (it is an all or nothing installation), and TOOT for longer-term projects as they are often built to make use of existing planned developments and would fail to give a strong CBA without these as a result.

ENTSO-E's answer: The question was if the scenario numbers should be adjusted based on the project's RES capacities (additional RES for PINT or reduced RES for TOOT)?

Q14. Interlinkage of gas and electricity on top of the scenario building: within the TNYDP 2022, ENTSO-E plans to introduce an indicator monetising the amount of hydrogen produced by P2G units. The variation of with and without the project to be assessed can then be considered as an addition to the general SEW.
The overall SEW benefit can then be calculated by SEW = SEW_el + SEW_H2

Do you consider this addition as the valid first step in further linking both sectors together?

Anonymous

Yes, this is a good idea.

ENTSO-E's answer: ENTSO-E appreciates this positive feedback

Yes, but gas prices should better reflect the reality of gas prices in Europe in terms of magnitude, volatility, and location.

ENTSO-E's answer: Acknowledged and the comment will be considered when further updating the methodology.

currENT Europe

We believe technology neutrality is relevant here: P2G bears consideration as a method for sector coupling, but ENTSO-E should not advocate for higher P2G as part of the modelling through an indicator monetising the amount of hydrogen unless the EU has a defined hydrogen target that is a defined input to the TYNDP.

ENTSO-E's answer: This can be seen as a first step to meeting the requirements of the upcoming revised TEN-E regulation. With this indicator, ENTSO-E is monetising the additional benefit from the change in H_2 output from P2G with and without the project. It is not assessing P2G projects, nor will it change the installed P2G capacity in the scenarios.

EDF SA

This issue is beyond the scope of the Implementation Guidelines and should be addressed separately with a view to improving the CBA methodology.

EDF considers direct electrification (except for those hard-to-abate sectors) to be the most cost-efficient way to achieve the EU decarbonisation objectives. The social welfare assessment of indirect solutions requires being cautious and has to be analysed further.

ENTSO-E's answer: The idea is to include such new methodologies within the Implementation Guidelines as test cases. After positive application in the TYNDP, such new methodologies could be transferred into the CBA Guideline.

Smart Wires

We believe technology neutrality is relevant here: P2G is one option; ENTSO-E should not advocate for higher P2G as part of the modelling through an indicator monetising the amount of hydrogen unless the EU has a hydrogen target that the TYNDP has to properly reflect.

The important thing here is how the P2G is calculated. IF P2G is proposed, it should be calculated like any other PCI either as:

1. A standalone project with the benefits of gas production and associated redispatch costs, including its CAPEX, losses, operations and maintenance and carbon costs of its final use.
2. As part of the network reinforcement with the CAPEX, OPEX and reduced capacity costs (both in market and payments)

ENTSO-E's answer: This can be seen as a first step to meeting the requirements of the upcoming revised TEN-E regulation. With this indicator, ENTSO-E is monetising the additional benefit from the change in H_2 output from P2G with and without the project. It is not assessing P2G projects, nor will it change the installed P2G capacity of the scenarios.

Q15. B7 indicators – Security of Supply – Flexibility: What, in your opinion, is the relevance of the "non-mature" B7 indicators (B7.1 and B7.2), as described within the 3rd CBA Guidelines in the overall CBA assessment of a project? **Do you think ENTSO-E should push to develop a methodology for all projects on a central ENTSO-E level, or should its assessment be kept at the project level and delivered by the project promoter?**

Anonymous

The answer is the same as for question 13. I do not think that having project-level indicators is a good choice.

Based on my understanding of the methodology, I think that the methodology is great for evaluating investments in transmission lines but not well suited to evaluating investments in storage or other technologies that are capable of providing ancillary services.

I am firmly convinced that SEW calculations should be performed in a way where the demand for both energy and ancillary services (FRC, aFRR, mFRR) are satisfied. I would appreciate a detailed methodological explanation as to why this is not the case already (I am convinced that this is technically feasible).

ENTSO-E's answer: ENTSO-E acknowledges that PLIs are not seen as a perfect solution and will further investigate the possibility of making them general indicators. Currently, it is not practically possible to assess the impact of a project on the ancillary services within the framework of the TYNDP due to the complexity of such studies.

EDF SA

This question is also far beyond the scope of the Implementation Guidelines and should be addressed when discussing improvements to the methodology.

ENTSO-E's answer: The idea is to include such new methodologies within the Implementation Guidelines as test cases. After positive application in the TYNDP, such new methodologies could be transferred into the CBA Guideline.

Smart Wires

Guidance is always good as it allows for the avoidance of gamesman ship by promoters. However, to do this and be fair, given that many of these assessments will be done using dynamic modelling, the SOs should make available dynamic modelling data (black-boxed for commercial reasons) to allow this type of assessment, and these models should be used by all promoters, not just 3rd party promoters but TSO/DSO as well.

ENTSO-E's answer: It is currently not practically possible to assess the impact of a project on the ancillary services within the framework of the TYNDP for all projects; given the complexity of such studies, this indicator needs to be treated as a PLI. As soon as such a methodology is available, it will be applied to all projects within the TYNDP.

The treatment of data availability and publication is not part of the Implementation Guidelines.

Q16. Besides the benefit indicators given within the 3rd CBA Guideline, **should any other relevant indicator be included in the CBA assessment?**

Anonymous

The SEW indicator calculation should better reflect the way power production portfolios actually operate and TSOs actually run power systems with sufficient margins. Therefore it needs to be calculated not only with an energy demand constraints but also with constraints reflecting FCR, aFRR and mFRR demand (the exact modelling of these constraints is up for discussion)

ENTSO-E's answer: Acknowledged and the comment will be considered when further updating the CBA Guidelines.

currENT Europe

The SEW indicator captures redispatch, which needs to be decided on centrally, as a key indicator of system performance across Europe. ENTSO-E should publish redispatch data and costs centrally once a year.

CurrENT also urges ENTSO-E to consider the need for an indicator that captures the use of network optimisation technologies consistently with the so-called NOVA principle (optimisation ahead of reinforcement ahead of new networks). Employing such technologies – in addition to expanding our networks – is crucial for a variety of the CBA indicators, including RES and SEW, as well as losses and flexibility.

The energy efficiency first principle should also be enshrined in the CBA approach, thereby emphasising the importance of overall system efficiency.

We also believe that the indicators must properly reflect the ability of technology solutions to address congestion and increase transmission capacity.

The CBA's Stability and Avoidance of Renewal/Replacement of Infrastructure also should be amended to include such benefits from network optimisation technologies as faster and more efficient deployment, redeployability and modularity.

ENTSO-E's answer: Acknowledged and the comment will be considered when further updating the CBA Guidelines.

EDF SA

EDF first considers that the CBA is a tool to objectively assess a project from an economic point of view on the basis of all the potential costs and benefits that can be monetised. The CBA delivers an assessment of the net social welfare of a project. It is not to be confused with the multi-criteria assessment that, in addition, takes into account non-monetisable criteria that will help prioritise projects. In such assessments, the qualitative insight and the relevance of these non-monetisable criteria are taken into account by attributing specific weighting factors that should remain transparent. Sometimes, the situation can become complex as some criteria may have both monetisable and non-monetisable costs or benefits, and this could potentially lead to double counting a given cost or benefit.

EDF is not very comfortable with the idea of taking into account many additional criteria in the assessment, as proposed by ENTSO-E. First, because many may raise monetisation issues and could lead to double (or more)-counting (see Q15) and, second, because it could put out of sight the economic efficiency criteria, which is essential to reach decarbonisation at the best cost.

ENTSO-E's answer: Acknowledged and the comment will be considered when further updating the CBA Guidelines.

Smart Wires

While the SEW indicator covers technologies that reduce congestion and increase network capacity, the aspect of avoiding curtailment and thus having more RES for less is not yet captured. What is more, there is a need for annual studies in the near term (2022 – 2025) and then 5-year studies after that.

There is a need for a requirement to demonstrate that optimisation must be carried out before new circuits are built. (the so-called NOVA principle of optimisation ahead of reinforcement ahead of new networks). The alternatives considered should be described, and a CBS carried out as part of the submission to ensure that projects being brought forth as PCIs meet EU and national legal requirements.

The CBA scalability and deferred investment need to be amended to include the benefit of early and speedy deployment, redeployability, and modularity.

ENTSO-E's answer: Acknowledged and the comment will be considered when further updating the CBA Guidelines.

SuperNode Ltd

The SEW indicator captures redispatch, which needs to be decided on centrally as a key indicator of system performance across Europe. ENTSO-E should publish redispatch data and costs centrally once a year.

The energy efficiency first principle should also be enshrined in the CBA approach, thereby emphasising the importance of overall system efficiency. We also believe that the indicators must properly reflect the ability of technology solutions to address congestion and increase transmission capacity.

ENTSO-E's answer: Acknowledged and the comment will be considered when further updating the CBA Guidelines.

TIWAG-Tiroler Wasserkraft AG

A monetised benefit should be shown not only for avoided CO_2 costs (ETS market value as well as avoided environmental costs) but also for avoided costs of non-CO_2 emissions.

ENTSO-E's answer: Acknowledged and the comment will be considered when further updating the CBA Guidelines.

Q17. Assessment of the commissioning years: In the TYNDP 2022, ENTSO-E is considering a method to assess the commissioning years of submitted projects in the case when no information is given within the latest available national development plan or when no update from the NRA exists. In this case, the commissioning year will be reviewed against comparable projects. For this test, all projects submitted to the TYNDP 2022 will be categorised by distinct criteria (e. g. technology, AC, DC, the project status, and the country they are built in). The commissioning years of the projects to be checked will then be compared against a group of comparable projects. This comparison will be made using the average of a specific factor, applied to all projects within this group, that calculates as x = (cost/capacity) * length.

Do you think this approach is sufficient in order to compare commissioning years? If not, what additional information would be needed to make the comparison – or what is not needed?

Anonymous

I do not have sufficient expertise to challenge this choice; it seems OK to me.

Yes, but also capacity (bigger towers) and territory (e. g., national parks).

ENTSO-E's answer: ENTSO-E appreciates this constructive feedback and will consider this in further improving this indicator.

Yes.

ENTSO-E's answer: ENTSO-E appreciates this positive feedback.

EDF SA

EDF welcomes the idea of improving the methodology by assessing the commissioning years to ensure the robustness of the analysis but, again, this question is beyond the scope of the Implementation Guidelines. At this stage, EDF is not able to comment on the formula proposed by ENTSO-E to calculate the specific factor. This requires a deeper analysis. ENTSO-E could engage with stakeholders and present why they chose this approach and the related hypotheses.

ENTSO-E's answer: Acknowledged and the comment will be considered when further updating this methodology.

Smart Wires

The group of comparable projects is not specific regarding whether this is within a country or region or of the same type in Europe. Countries have national and cultural issues that vary greatly.

The x-factor seems strange, a quad line and single conductor line can be a factor of 4:1, yet the cost is much the same. This could mean a group of quad lines in Germany of the same length would have an x-factor of as much as a quarter of Austria, which generally uses fewer conductors.

ENTSO-E's answer: Acknowledged and the comment will be considered when further updating this methodology.

After consideration of comments received from stakeholders in this consultation, bilateral exchanges with ACER and internal discussions, ENTSO-E decided to postpone the pilot implementation of this new methodology to TYNDP 2024. The methodology has therefore been removed from the TYNDP 2022 Implementation Guidelines, but is included in the draft version of the CBA 4.0 Guidelines under public consultation in December 2022 – January 2023.

Q18. Assessment of commissioning years: in relation to the previous question, **do you think that, in general, the length of an interconnection project has a major influence on its duration?**

Anonymous

I do not have sufficient expertise to provide a relevant answer.

currENT Europe

No. The primary factors affecting the duration of a project are largely independent of its length, for example, public acceptance and approval processes for the project and environmental factors.

ENTSO-E's answer: ENTSO-E appreciates this constructive feedback and will consider this in further improving this indicator.

Smart Wires

No. The relevant factor here is public acceptance and approvals for the project and environmental factors.

ENTSO-E's answer: ENTSO-E appreciates this constructive feedback and will consider this in further improving this indicator.

SuperNode Ltd

No. The primary factors affecting the duration of a project are largely independent of its length, for example, public acceptance and approval processes for the project and environmental factors.

ENTSO-E's answer: ENTSO-E appreciates this constructive feedback and will consider this in further improving this indicator.

Appendix 4 – Public consultation on the draft TYNDP 2022 package

Stakeholders comments

Open comments

Anonymous

Overall, amazing job, especially regarding the "Identification of offshore hybrid needs in the TYNDP system needs study".

However, some remarks:

- Lack of transparency on demand used for the different studies
- Demand provided by TSOs should be backed up with the additional information such as the number of electric vehicles, electric heat pumps, etc..
- Demand time series for Global Ambition and Distributed Energy should be provided for all weather years until 2019.
- Additionally, the demand time series for the areas used in the Identification of System Needs should be provided for all scenarios, horizons and weather years.
- Demand files for National Trends used in the studies have not been provided. Please provide them and do not just provide a link to other website. Moreover, the demand time series of National Trends have not been consulted as part of the scenarios and they are not being consulted now either. This is very concerning, considering that many of the studies such as the identification of system needs, are based on this scenario.

ENTSO-E's answer: All available scenarios data can be downloaded from https://2022.entsos-tyndp-scenarios.eu/download/

ENTSO-E must provide the scenarios, installed capacities, fuels, demand time-series, hydro time-series renewable time-series and CO2 price for all countries where there are projects (e.g.: Tunisia). The same applies for Corsica.

PEMMDB 2.3 files have not been provided decreasing the transparency of the processes. It is unclear what other technical parameters have been considered in the modelling. Without this data, it is not possible to reproduce the results.

ENTSO-E's answer: Scenarios data is available on https://2022.entsos-tyndp-scenarios.eu/download/. Data in PEMMDB 2.3 format is available under conditions upon signature of a NDA, please contact us to discuss it.

The identification of system needs has only candidates including transmission infrastructure, but no storage candidates which could save investments on transmission infrastructure. This should be analysed as part of the study, without giving any special preference to transmission projects.

ENTSO-E's answer: For the 2030 horizon, only transmission projects are studied because the zonal model used is too complex to allow an optimization on multiple types of candidates. However, for the 2040 horizon, both storage and peaking flexibilities have been included in the study alongside transmission projects.

Anonymous

CBA of projects that enable new generation distort the comparison of projects competing in the same border. CBA indicators should be recalculated without considering this additional generation and should be given to decision makers for reference.

ENTSO-E's answer: For Hybrid projects where interconnection is combined with installed RES installation, we reduce the SEW by its producer surplus using a specific Sanity Check. A distortion of the comparability is therefore not expected as only the effect of the transmission capacity increase is considered under the SEW.

The regional split of the capacities used for the Identification of System Needs must be published in a downloadable format. Moreover, if exist, PEMMDB 2.1 files must be published for them as well. Natural inflows, PECD and the demand time series for these regions must be published for transparency as well, including all weather years.

Grid capacity between regions of the Identification of System Needs must be published.

It is not clear how Demand Side Response was modelled. In particular, the prices at which Demand Side Response acts. This is especially critical in view of the current situation.

There is no information regarding technical parameters of generators, such as Forced Outage Rates, Maintenance Rates, etc. This is extremely important in view of the current situation that can be seen of nuclear units in France, among other cases. Moreover, ENTSO-E must use updated values that reflect reality in Europe.

ENTSO-E's answer: It is unclear to us what you mean by 'regional split of the capacities used for the Identification of System Needs' . The study is performed at pan-European level and results are published per border and per country. Input data, in the form or the starting grid, the list of investment candidates and the scenarios, is also publicly available.

'Grid capacity between regions of the Identification of System Needs must be published.' Identified needs are already published per border.

There is no information about the fuel priced assumed for Biomass and Biogas. Is this uniform across Europe? What is the value assumed depending on the country and Fuel?.

How do you model thermal units that must remain online due to system constraints? These constraints must be published as well.

All scenarios should have a 2050 version, including National Trends. Cost benefit analysis should be carried out for these 2050 scenarios as well. Cost benefit analysis results and scenarios should be published for 2050 as well.

Demand is a critical input to the TYNDP. The forecasting methodology and tools should be published.

ENTSO-E's answer:

Some units may have specific Biofuel price included in PEMMDB by the TSO, but if price is not given by TSO in PEMMDB then they take the price of the "primary fuel" in PEMMDB.

About the 2050 horizon: NT is based on NECPs, which do not expand until 2050. That is why there is no NT2050 scenario. The choice of scenarios/time horizons for which the CBA is carried out depends on requirements specified in the CBA Guidelines, on needs of the PCI/PMI process and on the project timeline. 2050 could not be included so far but its inclusion in TYNDP 2024 is a possibility.

Information on the methodology used to forecast demand is available on pages 44 to 48 of the Scenarios building guidelines https://2022.entsos-tyndp-scenarios.eu/wp-content/uploads/2022/04/TYNDP_2022_Scenario_Building_Guidelines_Version_April_2022.pdf

3d-Hydro Engineering GmbH

In the present draft of the study on system needs, it is welcomed that the required fihgures for the capacity of storage per member state are shown. It is well known that pumped storage power plants are the only sustainable option for large-scale energy storage.

The comparison of potential studies on storage capacity in Germany, Austria and Italy shows that with the existing potential, the capacities shown in the study on system needs can be covered without difficulty.

ENTSO-E's answer: Thank you for your positive feedback.

currENT

1 The TYNDP approach is safe and regulatorily sound. However, it is an incremental approach that builds on the existing grid and adds projects proposed with insufficient recognition of political agreements on EU-wide decarbonization of the energy system. There is a need for a different approach. We need to establish what is necessary for economy-wide carbon neutrality in 2050 and work back from there, planning and designing a transition to a fit for purpose grid infrastructure at a pan-European level. The optimal network needs to be defined as the reference grids for 2030, 2040 and 2050 time frames.

ENTSO-E's answer: Please see our replies to the same points raised in your other comments.

2 The TYNDP identifies the gaps between planned infrastructure and the needs of a 2030 or 2040 system that is based on national trends that are far from meeting the politically agreed climate and energy targets and ambitions.

According to the draft TYNDP 2022, "the System Needs study is not a network development plan" and "does not identify solutions". Europe should have a 30-year network development plan compatible with 55 % GHG reductions before 2030 and full decarbonization before 2050.

Anticipatory investment needs to be done in the context of a full decarbonization plan. The better the plan, the better the investment decisions will be. This is a big challenge in that few of the projects needed for 2050 will have a net benefit in isolation. A significant shortcoming with the current approach is that it will not necessarily result in the most efficient pan-European system. We need to assume an optimal system for 2050 – ideally, for Europe as a whole – and work our way back. Projects that deliver the highest contribution earliest should be delivered first, while factoring in their lead times.

ENTSO-E's answer: New EU targets will be considered in scenarios for TYNDP 2024. As the scenarios for TYNDP 2022 were finalised in early 2022, developed over 2021, and the data for National Trends collected end of 2020, it was not possible to consider changes in EU regulation. This has been discussed at length in a panel discussion on 'How to plan a decade ahead when the close future becomes unpredictable ?' with external stakeholders in a public webinar organised by ENTSO-E on 6 September 2022.

We would welcome further information on your proposed methodology to 'assume an optimal system for 2050'.

3 **Scenarios**

Faster scale-up of infrastructure will be needed to deliver on Net Zero in 2050

It is understandable that the scenarios do not reflect the stronger renewable energy and efficiency targets, given these have not yet cleared the legislative process. It is important that these are reflected in the TYNDP2024, together with the already agreed European Climate Law, with its 55 % reduction by 2030 and full 2050 decarbonization. However, basing the conclusions of the TYNDP by applying incrementalism to an outdated National Trends version of the future is somewhat misleading.

It would make sense to have reference grids for the different time horizons. The main reference grid should be the 2050 grid required for a decarbonized Europe – not the 2020 or 2025 grid. All reference grids must comply with the overall EU carbon reduction goals agreed by the European Climate Law (Regulation (EU) 2021/1119).

If the TYNDP is based on a scenario depicting today's grids plus those additional projects that are estimated to make it through current planning processes, the result will be a small, relatively inefficient grid, that will not be in line with a 2050 decarbonization pathway. For 2040, the TYNDP must reflect what is needed to reach European economy-wide decarbonization in 2050. For the electricity sector, that would require full decarbonization well before 2040. In addition, the infrastructure must be able to support the decarbonization through electrification of the heating, transport, and industrial sectors. The TYNDP 2022 does not currently provide such a path.

The Distributed Energy scenario (one of two scenarios, compatible with 55 % GHG reduction by 2030 and full 2050 decarbonization) appears to work with a similar final electricity demand as European 1.5-degree compatible scenarios. However, this scenario is not reflected in the identification of system needs, which is based on the National Trends scenario. It is surprising that that the second decarbonization-compatible scenario – Global Ambitions – is not mentioned at all in the System Needs report, despite the extensive consultations done on this scenario and despite the fact that this most closely aligns with intentions of the European Commission with respect to regional cooperation.

Moreover, grid enhancing technologies and other technologies that are expected to mature in the coming years, such as transmission technology based on superconductors, can significantly improve the efficiency of grids, affecting both the willingness to invest in new grids and the questions of when and where to invest in what kind of grid components. The TYNDP must assume the use of such existing as well as emerging technologies within the 2050 timeframe, when it would be socioeconomic beneficial to apply them.

While the Global Ambitions has not been discussed at all in the System Needs study, without a clear explanation, the other decarbonization scenario (Distributed Energy) has been allocated only one page, which notes that solar and wind would both need to double, compared to the National Trends scenario and that natural gas imports would fall by 50 %. However, none of the conclusions from the decarbonization scenario are used to identify system needs. This has very real and practical implications for European grid development. If the Scenarios are returning too few projects, they will not appear on the PCI list and will not benefit from accelerated planning and permit granting, or EU oversight, support and CEF funding. This will unnecessarily delay the needed overhaul of Europe's infrastructure development.

TYNDP 2024 and/or a future pan-European Network Development Plan must identify the gaps between what is presented in this TYNDP 2022 and what grid infrastructure and governance framework are needed for a decarbonized Europe.

ENTSO-E's answer: Regarding your first comments, please see our answer just above.

There seems to be some confusion as to what a reference grid is. A reference grid cannot 'comply with the overall EU carbon reduction goals agreed by the European Climate Law (Regulation (EU) 2021/1119).' It is merely an assumption of what the electricity transmission network may be in a given year, based on the existing grid and on known projects.

Our choice to focus on Distributed Energy in the comparison with NT in the needs report, and for the CBA, is justified by the fact that in previous public consultations we have seen ovrall more stakeholder interest in DE than in GA.

About Distributed Energy: you seem to have misunderstood this part of the system needs report. The table on that page is just a description of the two scenarios, nowhere is it said that 'solar and wind would both need to double, compared to the National Trends scenario and that natural gas imports would fall by 50 %.'.

4 Storage alone is not enough to deliver on Net Zero: all solutions will be needed

Compared to the TYNDP 2020, we see a great increase in the ambition for storage, but we need to make sure that this is the most cost-effective way to deliver on Net Zero in 2050. Currently, the TYNDP has to look at transmission and storage PCI projects, while Smart Grid PCIs are seen by TSOs as the place for grid enhancing technologies and these do not need to be assessed in the TYNDP to get PCI status. However, currENT believes that just because there is a Smart Grid PCI does not mean the TYNDP should not assess GETs, nor that it precludes transmission projects being 100 % or partially comprised of Grid Enhancing Technologies.

ENTSO-E's answer: Transmission projects proposed for assessment in the TYNDP can indeed include investments that are grid enhancing technologies.

5 System Needs

The System Needs study is certainly a useful exercise. However, it is largely based on projects brought forward by developers, evaluated against a set of technical and economic criteria, assuming a scenario based on national policies and trends from long before the European Climate Law was unanimously agreed and the decision to become independent from Russian fossil fuels.

The System Needs Report is right in pointing out that "a European power system transitioning towards high RES and aiming at climate neutrality in 2050, reducing needs is not enough. It is necessary to support the transition by preparing Europe's grid for a future with higher flows of RES electricity across border." A plan for this is urgently needed.

To illustrate, the TYNDP 2022 High-Level Report correctly points out: "a clear finding from our system needs study is that one of the main benefits of addressing system needs is to reduce Europe's dependence on gas-based power generation. By connecting more consumers with more producers, grid development allows a better use of the cheapest generation", and "The higher the price of natural gas, the more beneficial it becomes to invest in Europe's cross-border electricity grid."

Yet, the System Needs report only reduces gas-based power generation by 2.3 % in 2030 compared to a situation with no additional infrastructure investments. It states that gas-based power generation "would decrease by 75 TWh per year in 2040 (equivalent to 14 % of the electricity generation from gas in the EU in 2021)". That effectively means that 86 % of the gas generation will still be operating in 2040. As a consequence, the identified system needs are far from compatible with any political expectation of the future.

ENTSO-E's answer: You seem to forget that electricity infrastructure is one among the necessary components for the energy transition. Would you seriously expect infrastructure investments to single-handedly cut gas-based power generation by 100 %?

The energy sector is moving very fast and even more so with impacting international events such as the war in Ukraine. This is why TYNDP is updated every 2 year and the next TYNDP will take into account new ambitions.

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6 CBA Implementation Guidelines

The benefits of rapidly deployable solutions need to be further recognized in the TYNDP process. Rapidly deployable solutions enable network operators to quickly adapt to the changing needs of the grid, and maintain a high standard of security of supply in a cost effective and sustainable way. These solutions can lead to the quicker release of additional capacity on the existing network, and can often be re-deployed; giving greater long-term flexibility to network operators and increasing the robustness of grids against future uncertainties. Furthermore, solutions that provide pointed support to maintain grid stability and increase overall observability can enhance the preparedness of European power grids towards risks such as climate change and cybersecurity, thus strengthening the resilience of the network as a whole.

The CBA methodology needs to further evolve in order to meet the requirements set out in the TEN-E regulation

The CBA requirements in the TEN-E regulation (Annex V) cannot be fulfilled without examining earlier time periods. For example, energy efficiency measures do not take 10 years to implement, nor do solutions which do not require infrastructure, often being completed in 1-2 years. This means they could be very high value projects addressing current acute issues before 2025.

To assess the costs induced for the related system over the technical life of energy efficiency measures (Paragraph 8 of Annex V) and projects that do not require infrastructure, they need to have earlier years to meet this requirement. The largest annual benefit of these projects will be in the earlier years before other works can be completed, for which it will be otherwise impossible to model the market integration, security of supply and competition (as per Paragraph 4 of Annex V).

Also being able to show changes to commissioning dates of other projects (Paragraph 2 of Annex V), will require other years to be modelled and a change they will create in the scenarios to base that evaluation on. This will by default provide some sensitivity analysis. Equally, to be able to show how the energy efficiency principle (Paragraph 5 of Annex V) is implemented in all the steps of a TYNDP, energy efficiency first solutions will need to be tested to see what can be accomplished before adding in any other additional projects not already constructed into the model.

The cost of delays needs to be adequately reflected in the TYNDP process

The 'cost of delay' must be reflected in the assessment of TYNDP projects, and flexible solutions must be fairly valued. currENT advocates for optimizing the use of existing grids and reinforcement of grids as the first steps in grid development. While new grids are essential to meet certain long-term system needs, building new grids requires large amounts of capital investment, affects nature and typically takes many years to consent and develop. Public opposition and administrative hurdles to onshore developments make the implementation of approved projects challenging even with the vastly improved mechanism that now exists under the TYNDP and PCI processes today.

There is often a scope to better utilize available capacity on the existing grid by using flexible grid enhancing solutions. This can deliver earlier benefits to consumers while new infrastructure is 'in permitting' or under construction (e.g., by reducing constraint costs), continue to benefit or improve new infrastructure and can defer or eliminate some of the network needs. The value of reducing carbon emissions in the near-term and making progress towards a high-RES grid now is far greater than reducing the same carbon emissions in 10 years' time. This 'cost of delay' associated with large infrastructure projects must be taken into account when considering which project should be taken forward to meet an identified system need.

ENTSO-E's answer: You are right to state that non infrastructure solutions can generally be implemented faster than infrastructure solutions, but EU Regulation is specific that the TYNDP must assess 2 categories of infrastructure projects : electricity transmission and electricity storage. Therefore, when it comes to solutions the TYNDP assesses only infrastructure solutions, in the long-term. One of the overall objective of the TYNDP is to help decision-makers and investors identify no-regret options when it comes to infrastructure.

The topic of energy efficiency will be addressed in the next version of our CBA Guideline, expected to be released for consultation in December 2022. Your comments will be very much welcome.

Options to optimise the use of existing assets are already being considered by TSOs, see the example on page 25 of the system needs report where new infrastructure is the last option after all other options with less impact have been discarded.

currENT

7 Draft Implementation Guidelines & Hybrid Interconnectors:

The draft Implementation Guidelines state that "a massive uptake in offshore RES (predominantly offshore wind technology) is expected now and in the upcoming decades, aiming at above 60 GW offshore wind + 1 GW ocean energy by 2030 and 300 GW offshore wind and 40 GW ocean energy by 2050 in European waters, following the EC's offshore RES strategy."

Again, these projections seem far from market expectations. According to WindEurope, European governments have pledged to almost 160 GW of offshore wind by 2030 – 100 GW higher than assumed in the TYNDP.

ENTSO-E is correct to point out that the additional guidance for hybrid projects, beyond compliance with the 3rd CBA guideline, should "ensure consistency with the targeted wind capacity levels defined in the TYNDP scenarios and related reference grid as well as the targeted Offshore Wind Farms (OWFs) capacity in the expected future strategic Offshore Development Plans (ODP) at sea basin level".

These are due to be published by the involved MS in January 2023 for 2030, 2040 and 2050 in accordance with the revised TEN-E regulation.

We welcome that the Draft Implementation Guidelines include the notion of hybrid interconnectors and proposals on CBA options 1 and 2. However, introducing truly meshed DC overlay grids (within same market and/or between bidding zones) in the implementation guidelines, is very important moving forward.

ENTSO-E's answer: ENTSO-E assumptions on the numbers related to offshore development are taken from the EC Offshore Strategy published in November 2020. We are of course aware that the potential for the installed capacities could be greater than 300 GW by 2050 (and this is confirmed by the numbers included in the 2022 Scenarios). In the framework of the development of TYNDP 2024, with the redaction of the Offshore Network Development Plans, ENTSO-E will consider the most updated numbers coming from the committments of the Members States. The objective of the methodology is to set-up an approach that can be valid no matters the numbers considered and does not impose any blocking point to the development of the offshore systems in the European basins.

8 Governance models

The CBA options addressed in the Implementation Guidelines must be seen in the context of future changes to the governance model of the pan-European offshore grids, i.e., an Independent System Operator (ISO), an ISO per sea basin, or competitive models.

It is understood that ENTSO-E is preparing a position paper on roles and responsibilities in offshore network development. It would reportedly identify 5 potential models and assess them in function of different criteria such as complexity, number of stakeholders/contractors, experience etc. The models would include:

1. Onshore TSOs does everything
2. One offshore TSO per sea basin (owned by neighbouring onshore TSO)
3. Competitive model – light: third party only building the asset
4. Competitive model – no Independent System Operator (ISO): third party building, owning and maintaining the asset
5. ISO not owning the asset but doing the network planning, building and operating and maintaining the asset, currENT welcomes such a debate and suggest that future TYNDPs include a section on governance. We need a technically competent body, that does not own assets, to oversee the deployment of a pan-European grid, identify technology gaps and choices to bring us all the way to decarbonisation. If the endgame is a European grid, capable of supporting a decarbonised economy, then recognising this sooner will save money and enable us to get there quicker than otherwise would be the case, assuming rationality prevails. The TYNDP has a vital role to play in this. With such an approach we can model the energy system across all sectors and come up with a fit for purpose post carbon system that consumers can afford and rely upon.

ENTSO-E's answer: The governance model has no impact on the CBA assessment, as ENTSO-E keep a neutral position in the analysis of the indicators for a project, whether it is a TSO or a third party owned asset.

The TYNDP public consultation nor the TYNDP itself are the tool to discuss and advocate for policy and governance subjects, and these discussions should be kept in the dedicated frameworks.

currENT

9 The TYNDP 2024 must identify the gaps between what is presented in this TYNDP 2022 and what grid infrastructure and governance framework are needed for a decarbonized Europe. It is also important the updated renewables and energy efficiency targets are reflected in the TYNDP.

ENTSO-E's answer: Please see our replies to your previous comments.

Corre Energy BV

1 Corre Energy BV welcomes the publication of the draft TYNDP 2022 and the opportunity to provide feedback. As a leading developer of large scale, long duration energy storage projects, Corre Energy is disappointed with the lack of progress over several iterations of the TYNDP since the 2013 TEN-E Regulation in adequately capturing the benefits provided by energy storage.

Decarbonising the energy system requires increased deployment of renewable generation technologies, increased electrification of energy systems and increased sector coupling. The characteristics of renewable generation and the drive towards zero carbon will continue to change how we plan and operate the power system. Therefore TYNDP modelling techniques and tools must be adapted as soon as possible to take into consideration:

Uncertainty: Forecast error associated with renewable production means higher balancing requirements, greater need for reserves and higher value for flexible plant.

Variability: variability over all timescales impacts long and short-term modelling (multiple years, higher time resolution, regulation requirements etc.)

Investments: Technology value is now more impacted by operational phenomena, increasing coupling between investments, planning and operations, e.g. renewable curtailment and flexibility

Increased electrification and sector coupling: it is no longer adequate to consider electricity in isolation. Opportunities in heating, transport and hydrogen.

ENTSO-E's answer: Currently we are working on improving the methodologies also with respect to sector coupling: In the TYDNP an indicator has been introduced valuing the impact of H2 production of a certain project. Furthermore parallel to the TYNDP, ENTSO-E is performing a study based on an interlinked model between the gas and the electricity sector. It is planned to use this model and results as starting point for further improvements for the TYNDP 2024.

We appreciate your feedback and proposal on important measures to be considered for future system studies and are constantly working on improving the methods for future editions of the TNYDP.

2 The focus of the TYNDP CBA analysis in the evaluation of cost reductions in the wholesale day-ahead energy markets (SEW) neglects adequate consideration of flexibility that is essential to achieving the objectives of REPowerEU. The benefits of storage and demand response (electrolysis) extend well beyond simple day-ahead arbitrage. One of the main benefits provided by energy storage is derived from its flexibility – specifically its capability to respond to supply and demand rapidly, within-day.

This flexibility attribute which is key to achieving the envisaged power system is limited in the TYNDP to a KPI (balancing energy exchange) which when translated to a monetised value greatly underestimates the actual value. This is not consistent with the dramatic increase in RES planned between 2030 and 2050 which will lead directly to greatly increased needs for flexibility, balancing and reserves that are not reflected in the TYNDP process.

This failure to assess the full benefits of flexible storage has serious implications for selection of PCIs, as illustrated in the selection process for the 5th list of PCIs, when only 42 % of storage PCI candidate projects (excluding UK projects) attained a positive BCR, in contrast to 95 % of transmission projects. PCI designation is particularly important for innovative storage projects as they are promoted by entities without access to public funding and the innovation risk may need to be mitigated by EU co-financing.

ENTSO-E's answer: Within the TYNDP project assessment we apply a multi-criterial CBA assessment based on the requirements described within the respective CBA Guideline. It is then up to the European Commission to make decisions on the PCI lists – it is not up to ENTSO-E to make any weighting of the benefit indicators for the PCI process – all CBA benefit indicators are to be considered equally.

EDF

1 EDF would like to thank ENTSOE for the huge work that TYNDP requires. Since the first exercises, the format of publication and the quality of the released data have improved significantly. Even if EDF does not share ENTSOE's view concerning certain assumptions used to develop the scenarios (see our response to the previous consultation), EDF recognizes the quality of the work done and encourages ENTSOE to continue in this way. Among the 2022's improvements, EDF welcomes:

– Considering 3 different climate years in 2030 and 10 different climate years in 2040, which reinforces the robustness and the trust in the results.

– The inclusion of storage projects in the projects' list.

– The comparison between of Distributed Energy and National Trends.

The aim of the following comments is to suggest further improvements and should not eclipse the quality of the work done.

– The internal reinforcement costs are included in the total network investment. However, the internal reinforcement costs associated to each project are not explained.

– The Demand Side Flexibility could be an alternative to network reinforcement. It is not clear how this alternative is considered in the TYNDP.

– The commissioning years of projects seem to be based on "the Commissioning Year estimated by the promoter". Therefore, the trajectory of commissioning of new projects might be very ambitious. The TYNDP has been published every two years since 2010. This is therefore the 7th exercise. It would be interesting to give feedback and compare the estimated trajectory of commissioning in previous exercises with the reality.

ENTSO-E's answer: Thank you for your good feedback. Much appreciated.

Regarding improvements:

– internal reinforcement costs: estimates are provided by TSOs and are specific to each country and for each project, therefore it would be very complicated to provide explanations for all.

– demand side flexibility: when developing the draft system needs methodology the feasibility the inclusion of DSR was discussed but it was considered too complex, and therefore risky to have it in this TYNDP cycle. Especially considering having it in addition to the other innovations already introduced in 2022.

– commissioning years: A methodology to verify commissioning years is included in the draft version of the CBA 4.0 Guidelines under public consultation in December 2022 – January 2023.

2 Regarding the document "System dynamic and operational challenges", EDF thanks Entso-e for the large analysis and work performed to identify the future drivers of the system's stability. Among those, some potential mitigation measures have been listed by Entso-e to deal with frequency related aspects. All these measures seem quite interesting and complementary, except some like "Market restrictions in terms of reduction of the power exchange, and deployment of inertial redispatch" at page 15, that we think could be nefarious to the good operation of the European electrical system, and prevent some countries from getting benefit of an integrated European market through electricity flows via interconnections.

ENTSO-E's answer: Beyond other system stability challenges, the report presents a set of various solutions and mitigation measures that can contribute to secure the power system performance against frequency-related disturbances. Since there is no single solution to this issue, several measures for improving the resilience of the future system will have to considered and combined. In order to avoid the need for less effective solutions, or even last resort solutions such as market restrictions, it is important to enable all the necessary solutions measures. As an example, focusing on devices and grid users technical capabilities, the utilisation of grid forming control from HVDC links, or Grid Forming Capabilities and RoCoF withstand capabilities from generators will be essential.

Eurelectric

1 The long-term visibility of the TYNDP modelling should be improved. When selecting investment candidates at a given moment, the model has only limited degree of visibility on the evolution still required. TYNDP 2022 saw improvements in this approach by moving from a single time horizon approach to a multi-temporal approach. When selecting investment candidates at a given moment in time (eg: 2030), the plexos tool has a certain degree of visibility on the evolution still required (eg: increasing carbon price and electricity demand up to 2037). However, this is still not sufficient, and this must be improved.

Due to this limitation, the competitiveness of the different technologies and grid arrangements for meeting future requirements are not clear. Following examples could explain this limitation.

– The role of long-term storage to absorb the renewable surplus could be undermined because the model would prioritize to expand inter-connection capacities due to this limitation

– Similarly, if a certain network requirement (say due to 3 GW capacity addition on a 38 kV system) is known now to be needed for a country by 2030, this could be accommodated with Demand Side Response and some network investments. However, if it is known now about the network requirements for a capacity addition of 10 GW on a 38 kV system by 2040, there is little likelihood of any normal investment or DSM being able to accommodate it and some more radical approach will be required. Probably, an efficient strategy would be to upgrade the 38 kV system to a 110 kV system. Having limited degree of visibility in the model will avoid such rational decisions. With the current network models, improving this visibility is possible.

ENTSO-E's answer: Thank you for sharing these proposals for improvement of the scenario building process. Stakeholder engagement activities on the TYNDP 2024 scenarios will start in lat 2022/early 2023, we invite you to share your feedback then.

2 In the TYNDP scenario development and results, energy efficiency should be considered not just in energy end-use but also on total primary energy demand/supply. Total primary energy demand shows the use of total use of energy in its primary form before converting to electricity or other fuels or energy carriers. In the net zero scenarios there are significant energy losses resulting from the conversion of electricity into hydrogen and biomass into biomethane. Total primary energy demand includes the energy lost in those conversions and provides a more complete picture of the energy efficiency improvements in the scenarios.

ENTSO-E's answer: Thank you for sharing these proposals for improvement of the scenario building process. Stakeholder engagement activities on the TYNDP 2024 scenarios will start in lat 2022/early 2023, we invite you to share your feedback then.

3 Eurelectric would also like to highlight the need for strong involvement of DSOs in the TYNDP process. As the energy system is getting more decentralized with more renewable resources and flexibility resources connected to the distribution grid, there is an enhanced role for DSOs in shaping the whole energy sector. Following aspects will justify this enhanced role of DSOs

– More and more distributed energy resource means activities of DSOs will significantly influence the shaping of the energy system.

– DSOs will develop dedicated solutions for long-term sectoral plans

– DSO's grids, local balancing by DSOs, use of flexibility by DSOs will be key for the security of supply in the future.

– DSOs are rightly placed to anticipate the risks and threats to the system

– DSOs possess better knowledge, competences and basic data on the effective usage and operation of those resources

All these aspects above highlights the importance of engaging DSOs in the scenario building with a bottom-up approach and calls for an increased DSO-TSO cooperation in the TYNDP process. At the same time, it is necessary to define the framework for this cooperation on a partnership basis that is not only for the benefit of both parties but for the system.

ENTSO-E's answer: Thank you for sharing these proposals for improvement of the scenario building process. Stakeholder engagement activities on the TYNDP 2024 scenarios will start in lat 2022/early 2023, we invite you to share your feedback then.

Fortum Power and Heat Oy

1 TYNDP 2022 is an essential document package for developing the European power system as a whole and in particular the grid infrastructure.

TYNDP 2022 should also serve the energy market regulators in determining where additional grid infrastructure should be built based on European-wide socio-economic net benefits. It should not be left only to TSOs and other projects promoters to propose new grid investment projects but regulators should also take a more active role in requiring TSOs to initiate new projects where system needs are not covered by the TYNDP projects.

TYNDP 2022 clearly shows that there are many borders and regions where the proposed projects do not fully meet the system needs. These clear investment gaps should be further analysed e.g. in the Regional Investment Plans. Solutions should be sought to fill these gaps with additional projects either on these borders or on other borders in the region.

ENTSO-E's answer: Thank you for your comment. It is true that Regional investment plans have a role to play in identifying solutions when gaps are identified. In TYNDP 2022 Regional investment plans include a part on future challenges in the region, looking at possible studies to find solutions.

2 TYNDP includes good analysis of the system needs and the proposed projects on individual borders. However, TYNDP and its regional investment plans should also take a wider view on where the European grid infrastructure could be optimally further developed.

Now possible contributions of new both offshore and onshore links in the Mediterranean and North Sea areas and the Ukrainian borders are not fully visible. E.g. between Norway and UK (e.g. the Shetland Isles) there could be investment possibilities to further integrate the UK wind power and the Scandinavian hydro storage resources.

ENTSO-E's answer: For the 2030 horizon, only transmission projects are studied because the zonal model used is too complex to allow an optimization on multiple types of candidates. However, for the 2040 horizon, both storage and peaking flexibilities have been included in the study alongside transmission projects.

3 Regional Investment Plan -Baltic Sea has some old data for the EE-LV NTC values in Figure 3-3, some wrong (opposite) power flows (at least SE-FI & EE-LV) in Figures 3-6 and 3-7, missing historical RU-FI flows in Figure 3-7, and erroneous marginal prices in Figures 3-19 and 3-20.

ENTSO-E's answer: Fig 3.3: The NTC value on EE-LV is 900 MW in both directions. The values are correct.

Fig 3.6: SE-FI values have been checked and are correct. Values for EE-LV are there. Values for FI-RU have been added. Values for LV-RU have been moved to the right place.

Fig 3.7: values for RU-FI have been added

Fig 3.19 and 3.20 were of less relevance and have been removed

4 TYNDP has a good starting point in taking the EU level targets and the related National Energy and Climate Plans (NECPs) as an input to the TYNDP scenarios. However, the current NECPs are based on older EU targets. Thus, the current TYNDP scenarios don't meet the current more ambitious Fit for 55 and REPowerEU targets, which require a more rapid energy system change including e.g. more hydrogen production by electrolysis.

TYNDP 2022 system needs are studied only for the National Trends scenario. Although some comparison has been made for the Distributed Energy scenario, the Global Ambition scenario, incl. e.g. more offshore wind power, has not been taken into account for the system needs.

Thus, the TYNDP 2022 system needs and the project evaluation are most probably underestimating the future grid investment needs. This should be mentioned in communicating the system needs and taken into account in the project assessment. The climate targets of European non-EU countries should also be taken into account.

ENTSO-E's answer: New EU targets will be considered in scenarios for TYNDP 2024. As the scenarios for TYNDP 2022 were finalised in early 2022, developed over 2021, and the data for National Trends collected end of 2020, it was not possible to consider changes in EU regulation. This has been discussed at length in a panel discussion on 'How to plan a decade ahead when the close future becomes unpredictable ?' with external stakeholders in a public webinar organised by ENTSO-E on 6 September 2022.

HSE

As the largest electricity producer in Slovenia, the HSE Group closely monitors the development of the electricity network, so below we provide you with our view of the draft 10-year development plan of the trans-European network (TYNDP 2022), which is the subject of a public consultation.

The preparation of the EU-wide 10-year network development plan should take into account the full range of potential projects that can contribute to providing the necessary capacity for energy transmission and storage in the EU's ambitious renewable energy transition plan, which should be evaluated in the next step in the light of their need in the national, regional and EU-wide system and their readiness or feasibility status.

Given the current challenges in energy markets due to rising energy prices and a lack of production resources to ensure security of supply resulting from the accelerated transition to renewable energy sources due to coal phase out and the abandonment of Russian fossil fuels, a bottom-up approach is appropriate to allow for a faster selection of suitable projects already in the advanced phase and could be implemented and integrated into the grid as soon as possible.

In light of the decarbonisation of the electricity sector, Slovenia has taken the decision to phase out coal by 2033, which currently accounts for almost 30 % of electricity generation, and is therefore planning a significant increase in the use of variable renewable energy sources. Given national circumstances and the energy mix, the importance of energy storage will be a key element for the security of electricity supply in Slovenia and its neighbouring regions. The only Slovenian hydro pumped storage plant Avče is currently sufficient for these needs, with the further integration of renewable sources in Slovenia, which are required by decarbonisation, additional energy storage plants will have to be built in Slovenia.

More than a decade ago, electricity producer company Dravske elektrarne Maribor (DEM), which is part of the HSE Group, prepared a project for the new pumped-storage power plant Kozjak (PSPP Kozjak). The expected increase in the share of renewable energy sources in Slovenia and especially in neighboring European countries worsens the flexibility of the stability of the electricity system. The objective of the project is to generate high quality level peak energy during the time of daily consumption peaks, and it will also be important for the needs of fast reserve in the grid and for the systems of primary and secondary regulation and voltage regulation. Optimisation analysis of the plant capacity shows good reasons for construction of a PSP plant with the unit capacity of 2 x 228 MW and output of 754 GWh. PSPP Kozjak is integrated in electric power system in the heart of central Europe. It is included with all its benefits to three ENTSO-E regions, Central East, Central South and Central South East. Project is connected to HV grid that enables fast and flexible source of power (storage) not only for Slovenia but also for all neighboring power systems: Hungary, Austria, Croatia and Italy.

The project is in an advanced phase, a pre-investment study has already been carried out for it, and a decade ago the process of spatial planning was successfully completed in accordance with the requirements of national legislation.

The Slovenian national transmission network operator (ELES) addressed the project PSPP Kozjak in various electricity supply scenarios in the electricity system of the Republic of Slovenia, most recently in the preparation of the 10-year development plan of the transmission system of the Republic of Slovenia for the period 2021-2030, as well as in its previous versions. The PSPP Kozjak project was also included in the storage project in the 10-year Transmission Network Development Plan 2018 (TYNDP 2018).

We thus propose to include the project in the updated TYNDP and will participate in the designated call to propose projects, scheduled for next year.

ENTSO-E's answer: You are very welcome to propose this project for TYNDP 2024. We expect to release guidance on the process and requirements in the summer of 2023, and to organise the projects submission window in Q3 2023.

IFIEC

The TYDNP focuses on major infrastructure projects for the electricity grid.

All major projects under consideration are included. Two major issues however remain unclear:

1. What the outcome is of the Cost-Benefit Analysis (CBA). The way the CBA is done is clear, but because the outcomes are not transparant, we cannot properly react to this. This is relevant as investments between bidding zones also affect national investment plans.
2. It is unclear why the bidding zone review is not given much attention in the TYNDP. This is very surprising, as the projects assessed through the CBA are supposed to enhance market functioning; the bidding zone review meanwhile has the potential to vastly disrupt the market. Additionally, the impact of the 70 % rule is not mentioned anywhere, although this must have an effect on the TYNDP (and on which projects are the best investment).

ENTSO-E's answer:

1. regarding the outcome of the CBA, results are publicly available at https://tyndp2022-project-platform.azurewebsites.net/projectsheets and downloadable in spreadsheet and PDF format
2. it is unclear which role you propose for the BZR to have in the TYNDP (or the other way around?) The 2022 edition of the System Needs study does not take into account the 70 % rule, because ENTSO-E considers that for now there is not sufficient maturity or alignment of views on how to implement this rule in our models. There are workstreams ongoing with regulators and other actors, but no consensus has emerged so far.

WindEurope

We appreciate that ENTSO-E engaged on several occasions with WindEurope and integrated many of our comments in the development of the scenarios for the power system needs 2030-2040 estimation mainly about wind capacity and direct electrification shares

– We also appreciate that the current power system needs study and its accompanying documents have started addressing many of the concerns that we had shared for the 2020 version. Some examples include more explanations on:
  – how delays in delivering the current TYNDP projects are factored in the estimation of new capacity needs
  – much more detailed explanations on the estimation of needs for flexibility and other operational challenges
  – plans to better factor in the benefits of grid optimisation technologies
  – customised methodology to adequately evaluate the benefits of offshore hybrid assets

ENTSO-E's answer: Thank you for your comments

In your view, what is the relevance of non-TSO projects in the planning of the European network and how do you think it is reflected in TYNDP 2022?

Anonymous

These projects are very important since increase competition. They should be considered in same conditions as TSOs projects. For example, how many non-TSO projects have been considered in the starting grid?

ENTSO-E's answer: When building the starting grid of the system needs study and the reference grids the same criteria are applied to TSO and non-TSO projects. These criteria are specified in the CBA Guidelines section 2.5 (https://eepublicdownloads.blob.core.windows.net/public-cdn-container/tyndp-documents/CBA/210322_3rd_ENTSO-E_CBA_Guidelines.pdf) and relate to the naturity of the project. To know which projects are in the strating/reference grid please refer to the Starting grid published as Appendix to the report 'Opportunities for a more efficient European power system in 2030 and 2040' and to the reference grids published as Appendix to the TYNDP 2022 Implementation Guidelines.

Corre Energy BV

Non-TSO projects are essential to the developing network. In particular, large scale storage and electrolysis are needed, as acknowledged in the 2022 TEN-E Regulation, and TSOs are precluded from ownership of such projects.

ENTSO-E's answer: Storage projects are assessed in the TYNDP. Our question referred more to transmission infrastructure developed by companies that are not TSOs.

EDF

On the UK-French border, the French regulator CRE recently refused the demand of investment from Gridlink and is not favorable to Aquind. CRE has some doubt concerning the profitability for the collectivity of these projects. Moreover, in a 2019's study, CRE considered that zero or one project was relevant in this border. Therefore, we consider that it is unlikely that these projects will be launched/commissioned in the short term.

ENTSO-E's answer: All existing projects on the FR-UK borders are assessed in the TYNDP and results are available for regulators' consideration. It is up to regulators to decide which one, if any, of these projects should move forward.

Eurelectric

Non-TSO projects, like pumping storage not necessarily included in PCI list or complementary new industrial demands, could have a relevant impact on European Network. For instance, industry projects associated with decarbonization and/or hydrogen, as green steel production could represent up to 25 % of demand increase in some countries where they have been proposed. Those projects should be considered and reflected in TYNDP.

ENTSO-E's answer: According to EU Regulation two catgories of infrastructure assets must be in the TYNDP: transmisson and storage. Projects having an impact on demand would be considered in TYNDP scenarios.

Fortum Power and Heat Oy

Non-TSO projects are very relevant especially on borders where TSOs are not willing or financially not capable to invest in the needed additional interconnectors. Also, on borders where no additional system needs are shown in TYNDP 2022, non-TSO projects can be beneficial in meeting the tightened decarbonisation and energy security targets.

Especially in cases where system needs are shown and no TSO projects have been included, TYNDP and the TSOs should promote non-TSO projects. A regrettable case is the opposition (mentioned in the Regional Investment Plan -Baltic Sea) by the Swedish TSO Svenska kraftnät against the Latvia-Sweden LaSGo Link project (TR 1068), although system needs to increase the Sweden-Baltics transmission capacity are shown and the additional capacity would also serve power transit from northern to southern Sweden via Finland and Baltics, thus improving security of supply in southern Sweden.

ENTSO-E's answer: The main reason for the rejection of Transmission Invest's request to connect the project LaSGo Link to the Swedish transs mission grid is

insufficient capacity in the onshore grid to connect the proposed facility in a secure manner. Onshore reinforcements are being planned along the east coast, but these will not be in place to allow for a connection in line with the time plan proposed by the applicant. The assessment of the Swedesh TSO is that the security of supply in southern Sweden would be deteriorated – not improved – if coordination with the planned onshore reinforcements are neglected.

Another major concern regarding the proposed investment is that the Swedish Government has mandated Svenska kraftnät to take action to ensure the security of supply of the island of Gotland in close co-ordination with the relevant DSOs. Svenska kraftnät has proposed a preliminary investment plan that consists of two phases; the first phase being a redundant radial connection from the Swedich mainland to Gotland (ready by 2030 and size-wise co-ordinated with onshore reinforcements) and a second phase being a multi-terminal HVDC hub for offshore wind with a possible extension to the Baltic countries when all necessary onshore overhead lines have been refurbished.

This message was made public in June 2022: Commission regarding preparatory work for the expansion of the transmission grid into Swedish territorial waters (**svk.se**)

Svenska kraftnät's ambition is that the second grid investment phase for Gotland will be considered for inclusion in the next revision of the TYNDP. In this context, it should also be emphasized that the first phase commissioned already by 2030 handles three out of four main drivers attached to the LaSGo project:

1) Improved security of supply for Gotland,

2) enabling the local industries green transition and

3) enabling the connection of 1200+ MW of renewable on– and offshore energy.

This essentially means the LaSGo project's link between mainland Sweden and Gotland run an evident risk of being redundant.

In addition to the technical challenges, Svenska kraftnät has identified major legal concerns with the proposed project, the most important being that only Svenska kraftnät is allowed to own and operate new interconnectors according to the Swedish Electricity Act.

Mares Connect Limited

The TYNDP 2022 highlights the need for investment of approximately €6 Billion per year to avoid increases in energy bills of approximately € 9 Billion per year (a cost saving of €3 Billion per year). The TYNDP 2022 highlights that greater investment is required in the period from today to 2030 than from 2030 – 2040, due to the need to "catch up" to EU targets. Non-TSO projects which are developed with private capital are hugely important to ensure that the scale of investment required is in fact achieved. It is also important to attract private capital to these projects (including by providing the benefits associated with Project of Common Interest and Project of Mutual Interest status such as access to Connecting Europe Facility funding) so that state funds are freed up to invest in other parts of the economy.

Is the TYNDP consistent with the role of the power system in achieving the EU Green Deal and in identifying the value of infrastructure projects and the way forward? Any suggestion for improvement?

Corre Energy BV

The TYNDP is not fully consistent with achieving the aims of the EU Green Deal, as described above.

Additionally, we observe from the detailed data we have seen from TYNDP– there is no increase in reserve requirements for most countries between 2030 and 2040 despite the large increases in variable renewable generation. This leads to a concern that the flexibility needs of the future system are greatly underestimated and thus the value of flexible technologies such as storage and electrolysis are understated accordingly.

ENTSO-E's answer: Storage, electrolysis and other flexibility sources do increase significantly in all scenarios between 2030 and 2040, see for example in tab 28 and 33 of this file https://2022.entsos-tyndp-scenarios.eu/wp-content/uploads/2022/04/Updated-TYNDP-2022-Scenario-Report-Data_Figures.xlsx

currENT

currENT does not believe the TYNDP as it stands now is consistent with the EU Green Deal, as it does not show that it is aligned with a clear pathway towards a fully decarbonized European economy. currENT believes that Europe should have a 30-year network development plan that is compatible with 55 % GHG reductions before 2030 and full decarbonization before 2050.

ENTSO-E's answer: Fit for 55 will be considered in scenarios for TYNDP 2024. As the scenarios for TYNDP 2022 were finalised in early 2022, developed over 2021, and the data for National Trends collected end of 2020, it was not possible to consider changes in EU regulation. This has been discussed at length in a panel discussion on 'How to plan a decade ahead when the close future becomes unpredictable ?' with external stakeholders in a public webinar organised by ENTSO-E on 6 September 2022.

EDF

As expressed in the previous consultation, the main objective of the TYNDP is to identify the investments needed in infrastructures. This is in particular important as the energy transition and the current crisis entails a lot of uncertainties on the energy mix. Therefore, the TYNDP has to capture a large scope of possible futures to highlight the risks to invest in infrastructures and explore all the pathways of decarbonisation and not just reflect the ambition of TSOs. Moreover, there is a bigger risk of sunk costs in infrastructures and it is important to identify the no-regret options.

EDF considers that the TYNDP scenarios envisaged do not meet these objectives. Firstly, DE and GA bet on much higher development of the hydrogen produced from decarbonized power than National Trend, which is based on national objectives. There are many uncertainties concerning the development of hydrogen (storage capacities, renewable capacities for electrolysers…) and it is necessary to be careful concerning its development. The RES capacity needed needed to produce this hydrogen may be higher than the potential identified. EDF is not completely satisfied by the answer made by ENTSO-E and ENSTO-G on this particular point.

Moreover, electrification is recognized as the most cost-effective and energy efficient way to decarbonize final energy demand. A scenario with a higher electrification rate for final demand, consistent with Fit For 55 and RePowerEU plan, should be considered. Indeed, the electrification rates in the TYNDP 2022 scenarios (46 % in DE and 37 % in GA including the non-energy demand) are lower than what is envisaged in Fit For 55 (48 – 50 % direct electrification rate by 2050).

ENTSO-E's answer: The National Trends, Distributed Energy (DE) and Global Ambition (GA) scenarios of TYNDP 2022 have been developed prior to the Fit-for-55 package release. As such they use the 2020 EC Impact assessment as the main benchmark. The direct electrification rate of DE scenario in 2050 is slightly above this benchmark. It is is important to emphasise the definition of the direct electrification (we take into account final energy demand, energy branch, non-energy use and international aviation). Regarding hydrogen, DE and GA scenarios are in line with, or slightly below, the 2020 EU Hydrogen Strategy (10 Mt of green hydrogen in 2030) and not half as much ambitious than the proposed REPowerEU communication (20 Mt in 2030).

The TYNDP 2024 scenarios will offer the opportunity to fully implement the energy efficiency first principle, the Union's 2030 targets for energy and climate objective and its 2050 climate neutrality objective. The National Trends + scenario will aims at anticipating the future draft NECP to be in line with these targets. The new TEN-E regulation also requires to take into account the latest available Commission scenarios. Therefore, the level of hydrogen demand at EU scale will depend on targets, NECPs and EC scenarios. There will be still room to differentiate scenarios in terms of earliness of the hydrogen demand rise and expected long term level based on sectorial analysis for time horizon 2040 and 2050.

Taking into account the higher ambition in terms of energy efficiency in targets, we also expect a renew ambition for direct electrification especially in the space-heating sector and road transport segments.

In the end, all scenarios show that direct electrification of residential, tertiary and road transport as well as RES development are no regret options to be activated now.

We invite you to share your views during the first public consultation expected early 2023 on the input parameters including the demand scenarios . As communicated during our first public consultation on TYNDP 2024 in July 2022, we welcome any bilateral meeting you may consider useful.

Eurelectric

Though in principle compatible with 2050 climate neutrality ,TYNDP 2022 scenarios have less ambitious electrification rates (46 % in DE and 37 % in GA including the non-energy demand). This could underestimate the role of the power system in achieving the EU Green Deal and identifying the value of infrastructure projects. In the current context of energy price crisis in Europe, a greater role of electrification has been already acknowledged by policy makers which is visible in the latest RePowerEU plan of the commission. The RePowerEU plan is far more ambitious in terms of electrification compared to the Fitfor55 package. The 2030 climate impact assessment by the commission that was associated with the Fitfor55 package envisaged a 48-50 % direct electrification rate by 2050. This means that the direct electrification rate envisaged by the RePowerEU plan is more than this. Therefore, to properly benefit the potential of electrification and the power system in achieving the EU Green Deal, at least one of the scenarios of the TYNDP should focus on ambitious direct electrification as the major pillar for decarbonisation.

Furthermore, the policy priorities and targets in the REPower EU plan calls for a heavy push for renewable electricity, renewable hydrogen, and heat-pumps, supported by targets expressing an acceleration of the energy transition. Hence scenarios of TYNDP2022 may require a redefinition both in their components and in the dates and patterns of investment, to reflect REPower EU Plan. This could challenge the differences and justification of the current DE and GA scenarios.

Similarly, the TYNDP scenario development has not represented the sector coupling well in the sector coupling expansion model. This might cause underestimating the synergy between the power and gas sectors and could undermine the role of power sector in the decarbonisation. This must be improved in the upcoming TYNDP (Please see 10 for detailed explanation)

Scenarios should also consider the recent trends in EU such as digitalization. Recent hazards in the EU stresses the need to consider fully resilient electricity system on all voltage levels. With regards to the value of infrastructure projects, It is to be noted that it may be possible to utilise locally generated energy in a crisis situation to sustain for some time in the event of faults on the network. Flexibility services are key in such situations with higher local generation and flow of energy from energy storage.

ENTSO-E's answer: TYNDP 2024 scenarios will consider REPowerEU and Fitfor55. New storylines are being developed and are planned for release for consultation end of 2022/early 2023. Yours views will of course be very welcome.

Mares Connect Limited

The TYNDP is consistent with the role of the power system in achieving the EU Green Deal and identifying the value of infrastructure projects. The selection of Project of Common Interest and Project of Mutual Interest projects, which follows on from the TYNDP, is a very important step to facilitate the rapid development of those projects identified as being of key importance to the EU achieving its climate and energy objectives. MaresConnect welcomes the introduction of the Project of Mutual Interest category of projects to recognise the importance of supporting projects to connect more geographically isolated Member States such as Ireland. For privately-funded projects, the benefits associated with this status are important to ensure the rapid implementation of some of the EU's most important projects.

ENTSO-E's answer: Thank you for your comment.

SolarPowerEurope

We understand that the TYNDP 2022 was built based on scenarios that were developed before the war in Ukraine started. This makes the scenarios largely outdated, because the EU climate and energy landscape is very different today than it was a a year ago. Without factoring in the effects of the energy crisis and the EU's new ambition in renewables set out through REPowerEU, it is hard to provide a meaningful assessment of energy system needs and expectations in the medium and long term.

Similarly, as SolarPower Europe already flagged during the TYNDP 2022 Scenario Building process, national energy and climate policies are not necessarily aligned with EU ambition and at times do not correctly represent renewable technology current state of play. This issue was already reflected before the Ukraine war: we assessed that aggregated PV targets from NECPs were very unambitious compared to the EU Commission's long-term energy scenarios and much below market trends-based forecast for 2030.

We urge to reflect the rise in ambition towards renewables set out in REPowerEU, especially solar PV, in the TYNDP scenarios, and the accompanying energy system needs that stem out of that. REPowerEU outlines a target of 750 GWdc solar by 2030, with a strong push on rooftop solar.

In addition, we remain very critical of the approach of not having one central 2050 scenario indicating the most likely development of the energy sector, including sensitivities on the parameters that are used to build the two 2050 scenarios. The current approach does not indicate a clear direction for steering investment projects. It is questionable why certain parameters (e.g., large-scale vs distributed RES deployment) have been attributed to a larger extent to one scenario rather than another.

As a general remark, we would like to see a more attentive benchmark analysis of long-term energy modelling studies from both stakeholders and the academia, to outline what future developments in the energy systems could look like under different assumptions. This aspect, which in our point of view has been disregarded, would be extremely helpful when developing the scenario narratives towards 2050.

ENTSO-E's answer: New EU targets will be considered in scenarios for TYNDP 2024. As the scenarios for TYNDP 2022 were finalised in arly 2022, developed over 2021, and the data for National Trends collected end of 2020, it was not possible to consider changes in EU regulation. This has been discussed at length in a panel discussion on 'How to plan a decade ahead when the close future becomes unpredictable ?' with external stakeholders in a public webinar organised by ENTSO-E on 6 September 2022.

Scenarios for TYNDP 2024 will consider REPowerEU and Fitfor55.

WindEurope

Our major concern are the assumptions in the methodology for the Identification of offshore hybrid needs in the TYNDP system needs study (and consequently in the models that should be considered in the CBA implementation guidelines).

In the next years we expect new offshore wind farms to be integrated with the offshore and onshore grids in three distinct ways:

1. Type 1: Wind farms already auctioned and planned – to be radially connected at national level
2. Type 2: New wind farms to be auctioned and planned before that the Ten-Year Network Development Plan (TYNDP) integrates an offshore hybrid model in the CBA for individual projects (the latest by 2026) – still to be radially connected at national level
3. Type 3: New wind farms to be auctioned and planned after the TYNDP integrates offshore hybrids in the individual projects CBA (as of 2024 or 2026 to our understanding) – possibility to auction and plan these wind farms both at national or international level (e.g. planning and auctioning at country bilateral or sea-basin level)

The first two types are the ones that can be immediately deployed (coordinated by Member States) separately from the planning for cross-border interconnection (coordinated by MS and TSOs).

When it comes to our Type 3 above, our major concern is that the suggested candidate Type 2 in the "Identification of offshore hybrid needs in the TYNDP system needs study – methodology" only partly addresses the two options. We believe that a candidate Type 3 is missing from the suggested options:

The suggested candidate Type 2 in the system needs methodology: Unless the nationally planned wind farms are from the very beginning conceived, tendered, decided, financed, developed as assets already planned to evolve further as part of an offshore energy hub or to be interconnected with another country, there is zero possibility that they will evolve to offshore hybrid assets. Mainly because the initially settled contractual agreements for their finance will not integrate the high technical costs for evolving them to hubs or interconnected assets. Similarly there is zero possibility that existing radially connected offshore wind farms will evolve in this way.

This means that the Type 2 candidates presented in the study could only realistically reflect assets combining since their early design a national component for the development of the wind farms and an international one for the development of the interconnector.

This model can work only as a temporary solution and for a limited number of projects and. Given the large number of new wind farms to be planned and tendered and cross-border interconnections to be developed at sea-basin level, this candidate cannot be viable in the future for the bulk of expected assets. Considering the diverse lead times for auctioning, planning, permitting etc the different assets at national and international level, it will be very challenging to plan all these assets separately on time, some of them coordinated at national level and others at sea-basin or country bilateral level. Moreover, the spirit of the revised TEN-E regulation is the opposite: offshore infrastructure – generation and transmission– are planned in a closely coordinated manner at sea-basin level.

Additionally, as explained in the CBA 3.0 implementation guideline, none of the currently discussed market models is fully adequate to enable such initial offshore hybrid development as in Type 2 candidate (combining national and international elements). The Home-Market set up would require exemptions from the 70 % rule for the entire life-time of the projects to overcome the wind energy volume risk while for the OBZ set up to work it would require special configurations to overcome the wind energy price risk and revenue loss for the wind farm developer.

We suggest that the methodology under development can be already more forward looking given the large number of wind farms that have not yet been planned or auctioned. Therefore we sugegst that a candidate Type 3 should be modelled additionally as a single international asset that combines transmission and generation planned, tendered and developed together – with no need to change ownership and operation roles from today's practices – transmission asset owned and operated by the TSO, generation by the wind farm developer.

Later when this type of asset will have to be modelled in the individual projects CBA guideline in terms of market model it will require the consideration of cross-border auctions combining both the generation and the interconnection element and cross-border supporting mechanisms (e.g. cross-border 2-sided Contracts for Difference for the generation – at country bilateral level, sea-basin or EU).

Such configuration could accelerate the planning, finance and development of such assets (without violating the current unbundling rules) and could enable adequate market design. Our view is that such model should already be reflected in the system needs study and the CBA guideline. And its implementation should be investigated further from a regulatory perspective.

ENTSO-E's answer: ENTSO-E methodology for the assessment of hybrid investment candidates is a first step in the introduction of hybrid offshore systems in the identification of infrastructure gap analysis performed throug the Identification of System Needs.

The current version of the methodology focuses on the assessment of radial connections to be transformed into hybrid. However we agree that in the framework of planning an offshore grid, projects in which generation and interconnection assets are developed together might be an important component of the model. ENTSO-E intends to continue the evolution of the methodology in order to include more complex systems, better reflecting the configuration of the future offshore grid.

The tendering processes and ownership models are not impacting the IoSN modelling methodology.

The CBA modelling methdology is a different approach than the one for the Identification of System Needs, based on a similar, but separated model. The market arrangements currently included allow the project promoter to choose, based on the national set-up the most appropriate market design solution. However, as a defualt option, ENTSO-E consider the OBZ solution the standard one, given the benefits explained in the related position paper on offshore development market and regulatory issues. Currently, the CBA implementation guidelines consider both radial to hybrid projects and pure hybrid interconnection projects (option 1 and 2 of section 9.3 of the document), focusing however on the assessment of the transmission asset.

How should system integration be reflected in next TYNDP(s)?

Corre Energy BV

Modelling of Electrolysis and Sector-Coupling:

In the methodology for calculating the potential SEW benefit of electrolysis it is unclear if the additional sector coupling SEW is calculated as a post-processing exercise or if it is calculated intrinsically as part of the modelling.

Electrolysis increases system electrification and has the potential to make more renewable generation economical. It is also expected that it will have significant flexibility value.

Corre Energy has proposed numerous projects for both ENTSO-E and ENTSOG TYNDPs that integrate large-scale hydrogen production, hydrogen storage and hydrogen-capable CAES. Appropriate modelling techniques should be devised to establish the full value of such projects.

ENTSO-E's answer: The benefit of electrolysis is a part of the modelling results, i.e., it is not a post-processing exercise.

ENTSO-E and ENTSOG are working closely together to improve the modelling and assumptions for dual system CBAs.

However, for the TYNDP 2024 CBA assessments, ENTSO-E is no longer responsible for drafting the guidelines on how to assess energy storages. Instead, the Commission shall ensure the development of CBA methodologies for energy storages.

Eurelectric

Energy system integration is the planning and operating of the energy system as a whole, across multiple energy carriers, infrastructures, and consumption sectors. It creates stronger links between them with the objective of delivering low-carbon, reliable and resource-efficient energy services, at the least possible cost for society. Going forward, EU's energy transition must accelerate towards a more integrated energy system to achieve decarbonisation. TYNDP which is a bi-yearly pan-European plan for electricity development is an important tool to support EU's decarbonisation strategy. It should identify infrastructure needs to support an integrated and decarbonised energy system while ensuring security of supply. In this regard, system integration should be well represented and reflected in the TYNDP.

TYNDP exercise starts from the TYNDP scenario development. Sector coupling modelling in the TYDNP scenario development is important to represent system integration in the TYNDP. Although TYNDP 2022 made efforts to improve the sector coupling modelling, it is still inadequate. The sector coupling **expansion model** of the TYNDP 2022 focussed only on electricity and hydrogen systems with **minimal representation of the future methane system. The residual demand for methane** (shifting progressively from natural gas to biomethane and synthetic methane) **should be well represented in the modelling**. This should be the result of the interaction of market and technology and not a narrative drive outcome. The current approach which is very limited in terms of interactions between energy carriers will likely undervalue the benefits of system integration that could be achieved with a more integrated and comprehensive view on the energy systems, especially for achieving the decarbonisation targets in cost-efficient way for the consumers.

Moreover, **power-to-gas and gas-to-power flows should be better described and highlighted in the scenarios**, notably when it comes for two-week cold snaps, extreme daily peaks and "kalte Dunkelfaute scenarios modelling. Such scenarios are instrumental not only to assess the supply/demand balance of each system but also for identification of both adequacy issues or network congestion constraints. Improper identification of adequacy issues or network congestion constraints will result in overlooking the infrastructure investment needs.

ENTSO-E's answer: ENTSO-E, together with ENTSOG, is constantly working on improving the granularity and the modelling of sector integration and energy storages in the scenarios.

Fortum Power and Heat Oy

System integration between different energy carriers (electricity, gas, district heat, etc.) is an essential part of the future decarbonised energy system. In the TYNDP process, system integration should be especially considered in the common scenarios made together with ENTSOG.

In system integration, the storage of different energy carriers forms an important part in cost optimisation and in matching the energy supply and demand. Technology development and modelling of energy storage systems should be discussed in TYNDP in order to estimate the common potential of sector integration and energy storage.

ENTSO-E's answer: ENTSO-E, together with ENTSOG, is constantly working on improving the granularity and the modelling of sector integration and energy storages in the scenarios. Both associations are also working closely together to improve the modelling and assumptions for dual system CBAs.

However, for the TYNDP 2024 CBA assessments, ENTSO-E is no longer responsible for drafting the guidelines on how to assess energy storages. Instead, the European Commission shall ensure the development of CBA methodologies for energy storages.

What role should system adequacy play in the TYNDP?

Corre Energy BV

System adequacy should be an essential consideration in TYNDP. Storage plays an essential role in system adequacy and should be appropriately assessed as described above.

ENTSO-E's answer: Thank you for your views. The adequacy benefits delivered by storage projects in particular are assessed in CBA Guideline 3 by indicator B6. (however as per the revised TEN-E regulation the methodology to assess storage projects will no longer be specified in ENTSO-E's CBA Guidelines but will be developed by the European Commission)

Eurelectric

The ability of a power system to supply the load under different future circumstances is heavily dependent on the evolution of all the system generation capacity and infrastructure. In this sense, there is a clear interdependence between system adequacy and the infrastructure plans reflected by the TYNDP that must include a Europe-wide generation adequacy outlook built on the national assessment prepared by each TSO.

In practice, pursuant to the Electricity Regulation, the ERAA must properly take into consideration the level of interconnection, interconnection targets, and real network development (requirements of Article 23(5)(m), Article 23(5)(b) and Article 23(5)(l) respectively). Article 3 of the ERAA methodology (ACER Decision no. 24-2020) specifies that the assessment must reflect best estimates about the future state of the network based on the latest national development plans and ENTSO-E's TYNDP. Article 4 of the ERAA methodology specifies the modelling framework for the electricity network.

Therefore, system adequacy in parallel to system operation should be key for TYNDP. System dynamic and operational challenges address some of the issues that future European electric system will face but we miss a common approach. Will those scenarios raised on TYNDP and ERAA be stable in real time operation? Or will we find later operational limitations due to stability reasons that will not let that additional capacity to be used?

This common approach could lead to different investment decisions, like for example, less interconnectors and additional storage needs.

Consequently, further study on interlinks between TYNDP and ERAA (which respond to different time scenarios and follow different methodological paths) will be key to achieve a holistic approach on adequacy. This must be thoroughly analysed and then explained in documents released both for TYNDP and ERAA, as commented in answer to question 7. This will be the right basis for NRAA, when TSO must carefully assess the three pillars: system adequacy (by taking into account technologies abilities and competitiveness), operability (system security), grid planning (vis-à-vis grid expansion) and unveil the gaps between the anticipation and the reality and the need to refine prospects and more important, the need to introduce new regulatory and investment signals.

ENTSO-E's answer: Thank you for your views. ENTSO-E agrees that interrelation between TYNDP and ERAA ought to be explained, this will be further investigated.

Fortum Power and Heat Oy

System adequacy is one part in estimating the TYNDP system needs and in evaluating the TYNDP projects. ENTSO-E's ERAA (European Resource Adequacy Assessment) and its further development form a good basis for including system adequacy evaluation in TYNDP. Regional and national adequacy studies should also be taken into account in the project evaluation.

System adequacy should be considered also for the total energy system based on sector integration between the different energy forms (electricity, gas incl. hydrogen, oil, district heat, etc.). Energy storage technology development is an essential issue for future system adequacy and should be discussed in TYNDP.

ENTSO-E's answer: Thank you for sharing these ideas.

Any other recommendations for future TYNDPs?

Anonymous

Please publish more data and methodologies, and consult initial data and assumptions, methodologies, etc. More transparency is needed in general.

ENTSO-E's answer: All methodologies are published, please refer to the Scenarios building Guidelines, the Identification of System Needs Implee mentation Guidelines and the TYNDP 2022 Implementation Guidelines. In case of question on any of these documents please do not hesitate to contact us as tyndp@entsoe.eu

Regardind data, a lot of data is already available online, for example on https://tyndp.entsoe.eu/maps-data/, for scenarios on https://2022.entsos-tyndp-scenarios.eu/download/ and in the data visualisation platform, for system needs on the visualisation platform https://needs.entsoe.eu/ and on projects at https://tyndp2022-project-platform.azurewebsites.net/projectsheets. In case you cannot find the dataset you are looking for, please contact us.

Corre Energy BV

Model Size: Larger models usually require simplifications to be made making it more difficult to see the value of storage beyond simple day-ahead arbitrage. Perfect use of interconnectors is generally assumed. In a large model, the benefit of a single project will appear to be very small compared to total costs – the benefit may be drowned out by the optimization model's "optimisation gap". Geographic decomposition can mitigate this issue, see NREL SEAMS study https://www.nrel.gov/analysis/seams.html.

Development of the Interlinked Model for projects/clusters involving integrated electrolysis/hydrogen storage/electricity storage should be accelerated to be fully capable of assessing benefits for such projects by TYNDP 2024.

ENTSO-E's answer: Thank you for this comment. Please note that, according to the revised TEN-E regulation, the next version of ENTSO-E's CBA Guidelines will no longer include the methodology to assess storage projects.

currENT

Given the changes in network, dynamic analysis is now required to ensure system stability is maintained. The consideration of inertia is helpful, but adequate. Issues like phase oscillations, stability margins, voltage stability are becoming critical and the ongoing move to non-synchronous plant and equipment, e.g., most renewables and HVDC, is making this risk magnify. To date there is no test of the combined impact of these projects, which is beyond national processes. Checking the impact of solutions to these issues is necessary to say a solution or plan is viable.

ENTSO-E's answer: ENTSO-E welcomes the recommendation. It reinforces the TSOs direction to study the new stability challenges and corresponding mitigation measures. As mentioned in the report, TSOs are willing and ready to play their part in solving these challenges and to continuously improve their analysis and communication towards stakeholders. This chapter is the result of a continued effort and provides a comprehensive perspective on some of the main dynamic and operational challenges by explaining the technical background, their impact on the system and the relevant solutions or mitigation measures. It is the result of TSOs studies and best practice share to address the new stability challenges and corresponding mitigation measures.

Fortum Power and Heat Oy

TYNDP 2022 clearly shows that there are many borders where the proposed projects do not fully meet the system needs. These clear investment gaps should be further analysed e.g. in the Regional Investment Plans. Solutions should be sought to fill these gaps with additional projects either on these borders or other borders in the region.

The planned inclusion of offshore grid development plan in TYNDP 2024 is also an indispensable future improvement.

ENTSO-E's answer: On regional plans, please see our answer to one of your previous comments.

Mares Connect Limited

Consider adding the value of the reduction in RES curtailment provided by TYNDP Projects. In addition, as the proportion of non-synchronous power increases on European networks, there can be expected to be a greater need to provide ancillary services to maintain voltage and frequency on each network. The value of these ancillary services are relatively small at the moment (or in some cases ignored), however it is predictable these will increase materially and merit quantification.

ENTSO-E's answer: The monetary effect of reduced RES curtailment is to be considered as being fully included in the CO2 indicator and not seen as a separate benefit indicator. In addition the RES curtailment is provided under the B3 – RES integration indicator.

Further comment on the quality, clarity and length of TYNDP deliverables. How easy was it for you to understand TYNDP 2022?

3d-Hydro Engineering GmbH

In general the quality of the documents is perfect. Only the CBA guideline and the implementation guideline cover the same issues (sometimes contradicting). A single document would be desirable.

ENTSO-E's answer: Thank you for your positive feedback and for your suggestion regarding the implementation guidelines. Documents are separate because each document describes the methodology of separate studies. Additionally, it is foreseen in the CBA Guidelines that the TYNDP Implementation Guidelines should be released with each TYNDP.

Corre Energy BV

The TYNDP deliverables are reasonably clear and understandable.

ENTSO-E's answer: Thank you for your positive feedback.

EDF

EDF recommends the following improvements to the TYNDP deliverables to improve the quality, clarity and user-friendliness:

- Explicit cross references between the numerous documents to get a comprehensive overview when deep diving into one of the aspects raised in the report is missing. Including this will improve the overall understanding of the reports, otherwise, the reader must navigate between multiple deliverables.
- A balance worksheet resembling the ones from PRIMES scenarios would be of help.
- For the reader to compare with other scenarios, a detailed benchmarking better than the present one is needed in the TYNDP scenario report.
- On the TYNDP scenarios, building guidelines, although an appendix dedicated to the investment costs of various technologies are included, more details such as methodology for data aggregation would be highly recommended.
- A comprehensive aggregated analysis on overall cost and investments breakdown of the proposed scenarios for the entire energy system is missing. This will help to better understand cost-efficiency and economic implication of the proposed scenarios.
- The final power prices are missing.

ENTSO-E's answer: Your comments on the scenarios are out of scope of this consultation (because a separate consultation process was organised on scenarios), but will be shared with the relevant team for consideration. Please see also our answer to your next comment just below.

Eurelectric

Eurelectric recommends following improvements to the TYNDP deliverables to improve the quality, clarity and user-friendliness:

- We are missing explicit cross references between the numerous documents to get a comprehensive overview when deep diving into one of the aspects raised in the report. Including this will improve the overall understanding of the reports, otherwise, the reader must navigate between multiple deliverables.
- In the TYNDP scenario reports, a wider description of basic market changes in the energy sector, including flows of energy from distributed energy resources (bottom-up) and resulting from this increased role and new tasks of DSOs are to be given.
- A balance worksheet resembling the ones from PRIMES scenarios would be of help.
- For the reader to compare with other scenarios, a detailed benchmarking better than the present one is needed in the TYNDP scenario report.
- On the TYNDP scenario, building guidelines, although an appendix dedicated to the investment costs of various technologies are included, more details such as methodology for data aggregation would be highly recommended.
- A comprehensive aggregated analysis on overall cost and investments breakdown of the proposed scenarios for the entire energy system is missing. This will help to better understand cost-efficiency and economic implication of the proposed scenarios.
- On the visualisation platform associated with the TYNDP scenarios and the associated data sets certain improvements are welcome. More information on demand and the impact of flexible demand are to be provided. A datasheet in excel format for demand, generation, cross border capacities would be relevant. A visualisation by sector (eg: electricity) for demand as well as further details on the assumptions (eg: number of EVs, heat pumps) would improve the reader's perception of the scenarios. Similarly, in the datafiles, detailed explanation or description, legends and units are missing in some cases (eg: electricity market model results)
- Any graphs/figures in the reports are to be included in the visualization platform. This will help the user to get all data centralised in one point in a user-friendly way.
- There is no mention of GDP in any of the files. For the user to get the perspective of the economic growth in the scenarios and impact it has on the electricity demand, this could be included, probably, through energy intensity.

Finally, to enhance transparency and facilitate the interaction with stakeholders, homogeneous criteria of data handling and common formats in reports and excel files, together with an ad-hoc document explaining in detail the technical interlink between TYNDP and ERAA is needed. This could be key to have a holistic view of the planning process and cross-check consistencies and different approaches between both studies. An opportunity of improving this common approach could be tackled by Q4 2022, with the release of ERAA 2022. See answer to question 11 for more comments on the topic.

ENTSO-E's answer: Thank you for these ideas, especially your proposal to improve cross-referencing is something we will be working on. Regarding your comments that concern scenarios deliverables specifically, the public consultation process on scenarios was a separate process but your ideas will be shared with the team in charge.

We'll look into the desirability and feasibility of implementing homogeneous criteria of data handling and common formats between TYNDP and ERAA documents, though not for this ERAA 2022 (already in finalisation stage at the time when we assess the answers to this consultation) but for the next one. We agree that explanation on the technical interlink between TYNDP and ERAA would be a nice improvement and will consider it for next cycle.

Fortum Power and Heat Oy

The structure of TYNDP 2022 is clear, but it needs some expert knowledge to understand all the details. In addition to the European-level stakeholder events, it would be useful to arrange regional and national events that concentrate on the regional and national issues and especially the TYNDP Regional Investment Plans.

As the current main documents are still draft versions, it is understandable that some corrections need still to be done. At least the following points should be corrected to the final reports:

– System Needs Study report: The Figure 1.9 has a wrong map showing the year 2030 situation (same as Figure 1.8) instead of year 2040.

– System Needs Study report: Figures 2.9 and 2.10 include marginal cost intervals <2 €/MWh and 5-10 €/MWh but no 2-5 €/MWh. Should it be 2 – 10 €/MWh instead of 5-10 €/MWh?

ENTSO-E's answer: Thank you for your positive feedback. We are indeed considering the organisation of an event fosused on the regional level.

Thank you for pointing out these inconsistencies to our attention, they have been corrected.

Mares Connect Limited

TYNDP 2022 reports were high quality and presented in a way that was user-friendly. The webinar on TYNDP 2022 presented on 6 September 2022 was very helpful for navigating the documentation and highlighting key aspects. The short video on TYNDP 2022 presented at that meeting was a great public-facing tool for understanding TYNDP and the importance of investing in the projects selected.

ENTSO-E's answer: Thank you for your positive feedback.

WindEurope

1. The consultation consists of 10 documents treating different important issues. Some of them present clearly the deeper technical assessment and this is very helpful. However, it is not always sufficiently clear how ENTSO-E has integrated together the findings of these separate analysis or is planning to integrate them in the future TYNDP and power system needs studies' versions. An overview, potentially in an illustrative manner explaining the process of "connecting the dots" between the different pieces of analysis is necessary. This overview should show whether and how each one of the separate pieces of analysis, or their sub-elements, has been already used in the current TYNDP version or will be used in the next one.

2. The presented documents need to give much more transparency on how ENTSO-E validated its input data with the relevant stakeholders at the necessary level of detail and integrated them together to produce the study outcomes including data from generation, demand, TSOs and DSOs, prospects and status of grid development.

3 The visualisation platform for system needs is an excellent initiative and implemented in a helpful way. A helpful next step would be to provide the possibility to visualise on a single map the total cross-border interconnection needs together with the individual projects.

4 The selected consultation period (1.5 month during a by default holiday period between August and mid-September) is not promising for collecting well-elaborated feedback by the stakeholders. Moreover, some aspects need customised bilateral consultations with stakeholders for deploying more detailed data comparisons. The current presentation of outcomes and written consultation process is necessary but not sufficient for a detailed review of inputs and outputs.

ENTSO-E's answer:

1. thank you, this is a useful suggestion and we'll consider it for next cycle.
2. This comment seems to be about scenarios, which are not in the scope of this consultation (a dedicated consultation process was performed on scenarios). Your comments will be shared with the team in charge for consideration.
3. Thank you for your feedback and for the idea. Indeed it seems like the ideal next steps, it was actually considered initially for implementation in 2022 but was not done this time because our priority was to allow first the visualisation of needs and benefits. We'll consider it in 2024.
4. indeed the timing of the public consultation is not very fortunate. The many requirements on the TYNDP and the overall process, also including scenarios, unfortunately did not allow us to publish before the start of the summer. On the other side, the deadline set by the start of the PCI process do not allow us to wait until after the summer to start our consultation process.

However, please note that several bilateral discussions with stakeholders took place as part of the scenarios development process, the list of meetings is publicly available https://2022.entsos-tyndp-scenarios.eu/wp-content/uploads/2022/04/WGSB-2022_Stakeholder-Meeting-Log-FINAL.xlsx.

Appendix 5 – Public consultation on cost-benefit analysis results

Stakeholders comments

Open comments

Anonymous

ENTSO-E has not published any data regarding third countries in third countries in Africa. Please publish installed capacities by technology and fuel, hydro inflows, renewables profiles, demand time series, transmission capacities. They are necessary to understand the results of TYNDP.

ENTSO-E's answer: For the data regarding the modeled countries in Africa, please check our Final 2022 TYNDP Scenarios Package published in April 2022. You can download all the related data through download section from our website „download electricity modelling results" and view through the visualisation platform. Data includes DZ, EG, LY, MA, TN.

Acknowledgements

ENTSO-E would like to thank all the experts involved in the Ten-Year Network Development Plan 2022 for their commitment and enthusiasm in building this unique coordinated pan-European plan. In particular, ENTSO-E would like to thank the following experts who contributed to this report:

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Nuno Martins . . . . . REN
Joao Moreira . . . . . REN
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Belén Maria Segura Diaz . . . . . Red Eléctrica

Special thanks to

Stela Nenova . . . . . ENTSO-E

Design
DreiDreizehn GmbH, Berlin . www.313.de

Publication date
May 2023

ENTSO-E . Rue de Spa 8 . 1000 Brussels . Belgium