SRG

STAKEHOLDER REFERENCE GROUP

FOR THE TYNDP SCENARIOS

SRG OPINION ON 2026 TEN-YEAR NETWORK DEVELOPMENT PLAN (TYNDP) SCENARIOS

About this paper: This paper has been developed collaboratively by members of the Stakeholder Reference Group. The Group brings together a diverse range of stakeholders, united by the objective of providing timely, expert input into the development of the Ten-Year Network Development Plan (TYNDP) Scenarios.

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INTRODUCTION

Article 12(3) of Regulation 2022/869 (TEN-E Regulation) of 30 May 2022[1] specifies that ENTSO-E and ENTSOG "shall invite the organisations representing all relevant stakeholders, including the EU DSO entity, associations involved in electricity, gas and hydrogen markets, heating and cooling, carbon capture and storage and carbon capture and utilisation stakeholders, independent aggregators, demand-response operators, organisations involved in energy efficiency solutions, energy consumer associations, civil society representatives, to participate in the scenarios development process, in particular on key elements such as assumptions and how they are reflected in the scenarios data."

Article 12(1) of the same Regulation tasked ACER to develop Framework Guidelines on the joint TYNDP scenarios to be produced by ENTSO-E and ENTSOG. The Framework Guidelines, published in January 2023, state that the development of scenarios for the Ten-Year Network Development Plan ("TYNDP") process "shall follow as much as possible an open process to involve stakeholders, enabling a broad participation." For that to happen, the Guidelines required ENTSO-E and ENTSOG to create a Stakeholder Reference Group (SRG) within three months after the adoption of the Framework Guidelines. A call for interest targeted stakeholders listed in Article 12(3) of the TEN-E Regulation as well as other relevant organisations and independent experts.[2]

The Stakeholder Reference Group was established in autumn 2023, "with the aim of providing timely, expert input to the ENTSOs' development of scenarios in accordance with the ENTSOs' scenario development timeline."[3] The SRG has organised itself as an entity independent of the ENTSOs, and established terms of reference to guide the group's work. The SRG's tasks include, among others:

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[1] REGULATION (EU) 2022/869 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 30 May 2022 on guidelines for trans-European energy infrastructure (May 30, 2022), available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32022R0869&qid=1654587354725&from=en.

[2] ACER Framework Guidelines at para. 43.

[3] ACER, Framework Guidelines (Jan. 25, 2023) at para. 45, available at: https://www.acer.europa.eu/Official_documents/Acts_of_the_Agency/Framework_Guidelines/Framework%20Guidelines/FG_For_Joint_TYNDP_Scenarios.pdf.

- Scrutiny of inputs, assumptions and modelling methodologies
- Providing an informed and balanced view, reflecting majority and minority views
- Co-creation of stakeholder engagement plans (to be published by the ENTSOs)
- Evaluation of the scenario-development process and recommendations for improvements in the next TYNDP cycle.

To engage in these tasks in an efficient manner, the SRG has created four working groups that helped to organise the 'day-to-day' work of the SRG in the 2026 TYNDP cycle: Working Group 1, TYNDP Process Overview; Working Group 2, Demand and Transport; Working Group 3, Supply and Flexibility, and Working Group 4, Carbon Budget. In addition to their own work, the SRG has engaged with observers to the SRG, including the ENTSOs, ACER, DG ENER and the European Scientific Advisory Board for Climate Change (ESABCC).

From an operational perspective, SRG has organised itself to remain transparent, active and updated throughout the 2026 TYNDP cycle. The SRG's work has included dedicated meetings, workshops and exchanges with a thematic focus driven by the scope of the Working Groups as well as weekly SRG meetings, during which the updates on thematic-related activities and outputs as well as organisational, technical and administrative issues have been shared.

The document below provides **the SRG's advice to the ENTSOs on the 2026 TYNDP Scenarios process**, covering the main outcomes of SRG's discussions, **reflecting majority and minority views of SRG members**, as per recital of **Article (55) of ACER Framework Guidelines**. The earlier version of this document was shared out of courtesy with colleagues from the ENTSOs to make sure that the structure is understandable and messaging clear. The SRG appreciated the feedback received from the ENTSOs and reflected upon it in this advice wherever relevant, given the principle of **the SRG's independence** outlined in their terms of reference.

Furthermore, after the draft Scenario Report by the ENTSOs is published, the SRG will formulate an advice that includes a broader evaluation of the 2026 TYNDP scenarios-development process itself, and recommendations for improvements for the upcoming cycles, as per recital of **Article (67) of ACER Framework Guidelines.**

SCENARIO FRAMEWORK

The new scenario framework for TYNDP 2026, which follows ACER Scenario Guidelines, consists of one central scenario (National Trends+ or "NT+"), developed by ENTSOs based on updated National Energy and Climate Plans (NECPs), which is then complemented by two deviations, as economically induced variants. These two deviations are based on different levels for economic growth (high and low) as the main drivers of energy infrastructure development. Since the beginning of its activity, SRG was proactively requesting information and updates related to the development of the framework, and at the same time, SRG was delivering its considerations and ideas. Consequently, SRG was regularly informed about relevant developments by ENTSOs, but numerous uncertainties remained about the exact design of the framework.

National Trends+ use of the National and Energy Climate Plans (NECPs)

The central scenario (NT+) was developed based on the National and Energy Climate Plans (NECPs), and is, therefore, intended to illustrate the level of national political commitment, as a bottom-up approach. An initial challenge to relying on NECPs is that current NECPs were designed to meet 2030 targets, but not targets past 2030, and therefore most NECPs present demand and supply data only for 2030.

Another practical challenge in using the NECPs stems from the differences in and diverse quality of the NECPs. The varying data going into the central scenario raises questions about the consistency of assumptions applied across the central scenario. There is a lack of transparency and data around the national assumptions – this missing information and inconsistency exists across many sectors and assumptions, and across Member States in various ways. From the current practice, SRG finds it difficult for stakeholders or the public to assess the assumptions that TSOs applied nationally in the key demand sectors, such as buildings, industry or transport (see Section on Demand), or for other underlying parameters. This key limitation has been raised and discussed by the SRG throughout the 2026 TYNDP scenarios cycle.

Overall, it is difficult for stakeholders and the public to assess the scenarios as a result of the lack of consistency in the NECPs, and the limited transparency of the national-level assumptions and data sources deployed by the TSOs. The inconsistent data also causes limitations in assessing

how the TYNDP dispatch model implements national demand and supply capacity scenarios, and also subsequent investment, land and material needs. **SRG underscores that this issue requires dedicated attention in the next scenario cycle.**

Two deviation scenarios – high and low economic growth without storylines

In the new framework, the two deviations from the central scenario are based on the evolution of Europe's economy, as one approachable driver for policymakers and the public, and the high & low economic variants. According to the ENTSOs, the purpose of the economic variants in this cycle has been to serve as stress tests of the central scenario (as per Article 37 of the ACER Scenario Guidelines). ENTSOs have prepared these variants applying a top-down approach and as stress tests, the variants assumed a *narrow* differentiation between the central scenario and the high- and low-growth deviations – in other words, there is not a wide range that is tested in the modelling. This narrow analysis can be seen when the scenarios are translated into quantifiable indicators (see also Section on NT+ and Economic Variants Scenario Results). Implementation of the stress tests, and furthermore, prevented ENTSOs from carrying out the storylines process.

During the 2026 TYNDP cycle (mostly throughout 2024 and 2025, when the SRG participated in workshops on the modelling of economic variants), the SRG expressed reservations about the interpretation of the framework, where a central scenario and two quite conservative variants can resemble a "single scenario" approach. First, considering that the storylines process has not taken place in the 2026 cycle, stakeholders have not been able to provide input into the stories behind the scenarios or variants, a limitation that contradicted Articles 21, 28 and 38 of ACER Scenario Guidelines. Furthermore, in the previous TYNDP cycles, the two deviation scenarios called Distributed Energy and Global Ambition differentiated European pathways to climate neutrality and were thus *wider* by their nature. These deviation scenarios were accompanied and underpinned by storylines that explored greater variation in possible futures (see TYNDP 2024 Storylines Report). The absence of storylines in the top-down economic variants (or deviation scenarios), may make the TYNDP 2026 Scenarios framework less approachable or understandable to stakeholders and the public.

Second, applying economic variants stress tests and providing them as deviation scenarios, can present a reductionist view. While the economic variants could be interpreted as a story of the

future health of the economy and its linkages with the energy transition, previous analyses and studies (e.g., in Europe and beyond) suggest that economic variants are not the most important driver or uncertainty. The energy transition has an economic dimension, and it can be incorporated into a modelling exercise, but equally, there are many other types of important drivers, risks, and uncertainties for energy infrastructure.

SRG pointed out this challenge and underscored that uncertainties to the energy transition and to energy infrastructure development arrive from multiple sources, not only from economic fluctuations, as has been demonstrated by cascading crises of the 2020s, such as the pandemic and Russia's attack on Ukraine. In summer 2024, the SRG therefore collected a range of additional infrastructural drivers and key uncertainties that the SRG saw as important considerations, and shared this input with the ENTSOs. The SRG analysis identified a range of political, economic, social, technological, ecological, and cultural drivers as well as important uncertainties (including, but not limited to: resource scarcity/circularity, skills shortage, or manufacturing capacity), which could be highly relevant for Europe's energy infrastructure development and that could be potentially integrated into economic considerations. The diversity of such driving factors was reflected in the previous TYNDP cycle, when some high-level drivers were reported (see TYNDP 2024 Storylines Report), but they are not shared by the ENTSOs in the 2026 cycle, nor are any other scenario uncertainties.

Third, apart from the economic variants, a strict scenario-building timeline, combined with the introduction of a new scenario framework, has prevented ENTSOs from being able to conduct other sensitivity analyses. This limitation can be treated on the one hand as a deficiency in the TYNDP scenarios process, and on the other hand, as a lesson learned from implementation of such a specific scenario framework. It may be difficult to assess how infrastructure can be optimised without sensitivity analyses on other relevant topics.

SRG strongly recommends that storyline exercises (which also can benefit from horizon scanning, as a foresight technique), **should continue in future scenario cycles as they are an important element of scenario-building processes in general and can ensure stability across TYNDP cycles and fulfil requirements described in Articles (28), (34) and (38) of Scenario Guidelines.** The list of high-level drivers compiled by the SRG could serve as a starting point.

Communicating key data and headline figures

Communicating key data points about demand and supply, as a user-friendly dashboard, alongside information about the scenario framework, is important for the communicability of the TYNDP scenario framework for the stakeholders and for the public. This issue was already highlighted by the SRG in its feedback to the ENTSOs on the TYNDP 2024 scenarios (see especially proposals 3 and 9). The headline figures of the central scenario and the two variants are published only at the end of the TYNDP 2026 scenario cycle, once all modelling results have arrived, limiting the ability of the SRG to review this data. As a consequence, it has been challenging for the SRG to analyse the high-level picture of the scenario results. When these figures are received at the end of the cycle, it also raises some questions as to the extent to which the SRG has time to scrutinise and critically discuss these figures, and similarly, of the ability of ENTSOs then to provide necessary adjustments or changes to the framework, should issues be detected.

Benchmarking against other scenarios

The SRG also finds that clear benchmarking against other scenarios[4] needs to be improved in the TYNDP process, as per Article (53) of ACER Scenario Guidelines. This article requires the ENTSOs to "benchmark their scenarios with the most relevant external scenarios by providing a comparison of key inputs and outputs for the whole scenario time frame."

At the point in time of developing this SRG opinion, the benchmarking exercise had not been completed by the ENTSOs. As a result, it was not possible for the SRG to be fully involved in the benchmarking, demonstrating a misalignment of the benchmarking work within the larger scenario development process.

The SRG nevertheless made general observations about the benchmarking process, which it shared with the ENTSOs. First, while the Scenario Guidelines require benchmarking of both inputs and outputs, the ENTSOs have planned the benchmarking only once the TYNDP scenario results are complete, suggesting that they would be looking only at outputs. Throughout the 2026

[4] As per article (53) of ACER Scenario Guidelines.

TYNDP Scenarios process, it was not clear to the SRG whether benchmarking of inputs took place. If it did not, this deficiency can be interpreted as serious shortcoming as benchmarking should also inform the scenario development. Second, although the Scenario Guidelines recommend that the SRG could provide the list of external scenarios to be used for benchmarking[5], the SRG was informed, only at the time of finalisation of this opinion, of the scenarios that the ENTOS are planning to use for benchmarking for TYNDP 2026 scenarios: the Impact Assessment on 2040 climate targets, the EU Joint Research Centre (JRC) scenarios (December 2024), and the IRENA's Regional energy transition outlook (2025). The EU Reference scenario (2021) had not been updated by the EC for this TYNDP scenario cycle.

The SRG recommends that both ENTSOs and the EU institutions study the inputs, outputs and lessons learned from key alternative scenarios offering long-term climate and energy outlooks, produced by other recognised entities. Such recent scenario studies, with their key messages, may include (at least) the following:

- European Scientific Advisory Board for Climate Change (ESABCC)'s recommendations towards the 2040 climate target (2023-2024). ESABCC (2023) screened 1 000 scenarios, then hen filtered them into 36 scenarios to identify three types of "iconic pathways: 1) demand-side focus pathways, 2) high renewable energy pathways, and 3) mixed options pathways". The analysis also provides feasibility thresholds and guidance for infrastructure development. These thresholds address geophysical, technological as well as socio-cultural feasibility criteria, all of which have been quantified and also cited.
- In addition, an assessment of major EU and climate scenarios with a view to the 2040 milestone on climate ambition and feasibility by the négaWatt Association (2025) compares different scenarios, including TYNDP 2024 scenarios, based on their key headline indicators.
- Agora Energiewende study (2025) on a climate-neutral energy system discusses the benefits of integrated planning, demonstrating the resulting cost-savings with four scenarios. It also advocates open-source modelling across energy carriers, as a best practice.

[5] What the SRG did, while sharing an initial draft of this document.

- Other scenario studies, such as "Collaborative Low Energy Vision for the European Region" (2023) and "Paris Agreement Compatible Scenarios for Energy Infrastructure (2024)" articulate how the integration of demand-side measures helps in optimising energy supply, and in minimising land-use and spatial requirements, material use and resources, and highlight the amount of needed investment as an important consideration, owing to the financial aspects related to the energy transition.
- Climate and energy studies published in the academic realm, and updates on related developments could further strengthen alignment with science-based needs.
- Concerning the carbon budget, SRG recommends that the ENTSOs continue to benchmark against ESABCC recommendations and for future TYNDP cycles, assess latest developments on carbon budget aspects, with a view to the on-going IPCC scenarios and a new process. [6]

As noted above and in ACER's Scenario Guidelines, the benchmarking exercise is required to compare results and also highlight deviations in the scenarios. The benchmarking should therefore go beyond a mere comparison of results but should also highlight different inputs and methodological differences across the studies. Scenarios include different underlying assumptions about our society and the future energy system, and, thus inputs and results may vary significantly across different studies. Without taking a hard look at the inputs and deviations that lead to those different outcomes, the benchmarking does not accomplish its intended purpose.

SRG recommends that the ENTSOs advance an increasingly proactive scenario-building approach for enhanced comparability across tools, data and datasets used. The TYNDP scenarios, including the ones from the 2026 cycle, are an important data source not just for the TYNDP itself but more broadly. Stakeholders and experts use the data from the TYNDPs as inputs for upcoming cycles, for generating new results and to give useful guidance on where further innovations will be needed. **As a general recommendation, open data frameworks and open-source methodologies would make benchmarking and replicability easier**.

[6] *See* IPCC CCS CCU CDR Methodology report 2027 (outline has been published and a methodology report is expected).

Another issue observed by the SRG concerns the timeline of the TYNDP scenario-building process. The strict timeline constraints in the TYNDP 2026 scenario-building – in addition to constraining time for SRG review – have limited some SRG suggestions, such as requests for sensitivity analyses or more detailed assessments on demand. A lack of such analyses may pose limitations on the usability of the scenarios. If the only limitation on such analyses is a lack of time, a greater allocation of time into the scenario timeline should be investigated in the future. Further guidance will also be needed on how the TYNDP 2026 framework, with the two variants as deviations without storylines, will be used for the TYNDP 2028 scenario cycle. **For the TYNDP 2028 scenarios cycle, the SRG already recommends that the ENTSOs evaluate timeline adjustments to allow for other analyses to be conducted, also considering the open-source possibilities**.

Results on modelling the central scenario (NT+) and economic variants

The ENTSOs shared the intermediate results of the TYNDP 2026 scenarios with the SRG with request for feedback under a very constrained timeline. As a result, the SRG's review of results for this report is limited. The SRG did not have time to perform a detailed assessment of hourly outputs and focused instead on the KPI dashboard, which provided a useful high-level overview of system performance and enabled the identification of key trends and inconsistencies. Because of the complexity and magnitude of the task, combined with a short deadline, these insights have been shared with the ENTSOs as observations and not as formal SRG recommendations.

Key observations from the first iteration

The initial results revealed several important concerns across both the central scenario and the economic variants:

- **Misalignment with NECP targets**: Renewable deployment, particularly wind, appeared inconsistent with 2030 national targets in several countries (e.g., in Spain), raising questions about underlying assumptions.
- **Internal inconsistencies and plausibility issues**: Some results appeared unrealistic, including very high curtailment levels (e.g., in Ireland), implausible EV charging peaks (e.g., in Germany), and contradictory combinations of low prices, low utilisation, and high renewable shares.

- **System adequacy and reliability**: The model showed low firm capacity relative to average load, alongside sometimes low utilisation of nuclear and gas. This has raised questions on reliability and whether such assets remain "in the money." While typically outside TYNDP scope (more relevant for ERAA), it was just flagged by the SRG, though not assessed in detail.
- **Price signals**: Inconsistencies between electricity and hydrogen prices suggested unrealistic arbitrage opportunities and distorted investment signals.
- **Hydrogen and e-fuels modelling**: Limited transparency and structural inconsistencies were observed, including unclear demand drivers, missing grey hydrogen in 2030, and questionable CO_2 accounting.
- **Transparency gaps**: It was often unclear how key variables were defined (inputs vs. outputs) and how different parts of the system were linked.
- **Relevance of economic variant scenarios**: Differences across variants partly reflect modelling choices, as capacity was kept constant. This can make high-demand scenarios appear less favourable due to higher prices. Allowing supply and flexibility to vary with demand would provide more realistic outcomes and better inform investment needs.

Following the SRG's feedback, the ENTSOs made several improvements in the results shared in **the second iteration**:

- **Better transparency and usability**: Clearer data structures (including input/output distinction) and improved disaggregation enhanced the interpretability of results.
- **More consistent price signals**: Electricity and hydrogen prices followed more coherent patterns across scenarios.
- **Improved system behaviour**: Some unrealistic outcomes, including extreme price spikes and energy-not-served, were reduced, and key indicators (e.g. hydrogen demand, flexibility use) show more plausible trends.

Despite progress, several issues and challenges persisted:

- Ongoing internal inconsistencies in some countries
- Limited improvements in hydrogen and e-fuels modelling
- Continued concerns on investment signals
- Structural limitations in the design of economic variants
- Remaining gaps in transparency and system boundary definitions

The SRG welcomed the improvements, particularly in transparency and consistency. However, further work is needed to address remaining structural issues and ensure that TYNDP scenarios provide a robust and credible basis for investment and policy decisions.

PROCESS

The TYNDP Scenarios 2026 is the first full cycle of involvement with the Scenarios Stakeholder Reference Group.

Implementing SRG advice

Prior to this cycle, SRG provided recommendations on TYNDP Scenarios 2024 results in February 2024 (link). During this cycle, SRG would have expected more clarity on how their 2024 recommendations (link) were applied for the TYNDP 2026 Scenarios.

Notably, during the 2026 TYNDP Scenarios cycle the ENTSOs and the SRG created a tracking system in order to allow for regular checks and follow-up on different action points. This system has proven to be a useful tool in ensuring continuation and consistency in implementation of certain pending tasks and follow-ups. For it to fully serve its purpose, however, it requires improvements considering its efficiency, level of details and the resources needed to guarantee diligence.

In the 2026 TYNDP scenarios cycle, SRG has provided feedback mostly in two distinct ways: (1) during numerous interactions, including weekly meetings, working group meetings, thematic workshops, dedicated calls or email exchanges, commenting inputs, solutions or pending questions; and (2) and through a formal voting process that allowed the SRG to adopt topic-specific recommendations. SRG has provided advice through six distinct sets of recommendations, all available online:

1) Stakeholder Engagement Plan for the TYNDP 2026 scenarios
2) Innovation Roadmap
3) Gap Filling Methodology
4) Commodity Prices
5) Interlinked Modelling Process (ILM)
6) Enhancing Transparency in Demand Modeling

In addition, SRG reviewed questions by ENTSOs for the main public consultation of the scenario cycle on input assumptions, data, parameters and methodologies that took place in June-July 2025 (link).

Engagement of stakeholders and the SRG

On stakeholder engagement, SRG provided the ENTSOs with 8 recommendations on the 2026 cycle's Stakeholder Engagement Plan (link), which articulate the importance of process visibility and regular timeline updates that ensure high-quality stakeholder engagement.

SRG has emphasised that it is important for ENTSOs to define overall and specific aims and objectives in engaging with different stakeholder groups. Further detail should include precision on the formats of engagement and feedback collection at each step of the scenario-building. In addition, it will continue to be important to differentiate when the SRG, and when other stakeholders are involved, and for what reasons. Overall, SRG recommended to the ENTSOs to always articulate the type of stakeholder engagement: informative, consultative, co-creative or joint activity, with foreseeable timelines, and adequate time for feedback. Throughout the 2026 TYNDP cycle, SRG has witnessed substantial improvement in ENTSOs meeting these objectives, but encourages them to further develop these practices.

When ENTSOs organise workshops and other exchanges with the SRG or the wider public, SRG underscores the importance of clarity, clear definitions of aims of the meeting or the workshop, as well as applied methodology, and associated terminology, especially in moments when technical results from the modelling work are presented in multiple phases, to ensure inclusiveness and the quality of stakeholder engagement. SRG continues to encourage a diversity of views to be collected by ENTSOs through public workshops, consultations and other formats, at the key moments of each scenario cycle. Concerning the preparations to the Public Consultation in July 2025, SRG sees that it could have been challenging for stakeholders outside of the SRG to understand the premises of the questions asked in the consultation. In addition, hydrogen aspects were not incorporated into the consultation materials (see also Section on Supply, especially the paragraphs on Hydrogen).

As a sound practice, SRG appreciates that ENTSO-E and ENTSOG publish a summary report from feedback in public consultations (**and in the future, recommends similar practices** involving ENNOH). Using the 2026 Scenarios Consultation Summary Report as an example, SRG recommends including, in future consultation summary reports, how the inputs received were considered, providing further details of planned response for each individual topic consulted.

Cut-off date

The cut-off date to the TYNDP 2026 scenario-building – which concerns the inclusion of different policies, such as NECPs, into datasets to be considered in TYNDP 2026 scenarios – was set for 24 December 2024. ENTSOs informed the SRG of taking this decision, but SRG was not consulted on it, as required by Article 19 of ACER Scenario Guidelines. In 2025, the European Commission introduced a 2040 climate target, submitted to the European Parliament and the Council, to be voted by the European Parliament, which SRG expects ENTSOs to systematically incorporate into the TYNDP 2028 scenario cycle.

Furthermore, **SRG suggests a more forward-looking approach for future TYNDP scenario cycles, when it comes to considerations of upcoming policies and their implications**, which might have substantial impacts on parameters, assumptions or overall modelling architecture, such as the electrification target (foreseen in the EU Electrification Action Plan) or the implications of the Carbon Border Adjustment Mechanism (CBAM).

Overall, SRG has recommended that ENTSOs enhance how collected input informs operative work. Witnessing improvements on this, further progress is recommended to explain and specify to the SRG how its feedback has been treated.

INNOVATION ROADMAP

In the 2026 TYNDP scenarios cycle, SRG was consulted on the Innovation Roadmap and provided 12 recommendations (link). In the current TYNDP cycle, it was not clear how improvements in the Innovation Roadmap to the TYNDP Scenarios and overall improvements on the Interlinked Modelling Framework (ILM) are connected (see also the Section on ILM).

A key issue raised by the SRG was clarity over which innovations should receive priority, and why. Although SRG's feedback was partially recognised, further improvements are requested. To be precise, the status of implementation of different innovations is not clear from the Innovation Roadmap due to its current format. **SRG recommends the implementation status of each innovation to be provided, and expects a timeline of implementing innovations to be**

established, whenever possible, as per Scenario Guidelines Article (47). Transparent documentation (link) on innovations and recommendations that have not been addressed should be established.

The practice of ENTSOs that evaluated the potential to implement innovations was based on internal operational criteria, based on resources necessary for implementation and potential impact achieved. This approach seems to have limited consideration of **external criteria**. In this cycle, SRG already recommended, for example, that **advice for climate-neutrality, including from the European Scientific Advisory Board on Climate Change (ESABCC), should receive a high priority.** SRG has not progressed with recommending a comprehensive methodology on how innovations could be prioritised – an activity that can be taken up in the upcoming 2028 TYNDP cycle. Appreciating that the Innovation Roadmap (link) is intended to be a living document, annual reviews are proposed. As a basis of these reviews, SRG recommends a proactive approach and process follow ups by the ENTSOs. These reviews would transparently inform stakeholders which innovations have been considered, included from the previous cycles, or omitted. In addition, it would outline the status of each innovation and an explanation of that status. The SRG also asks ENTSOs to openly invite recommendations from a wider group of stakeholders, also outside of the SRG, and to plan for the most suitable modality to do so. The revision should also seek for potential synergies with other tasks and activities related to scenarios building.

As this analysis is an important moment in the scenario building cycle, SRG also could be involved in such assessment. SRG needs sufficient time, which will allow it to discuss and develop its advice, before ENTSOs formally adopt decisions related to selection and following implementation of specific innovations.

METHODOLOGY

The Innovation Roadmap provides a useful overview of the toolchain that is used for the 2026 TYNDP scenarios. It would be helpful if the description of this toolchain is expanded with more comprehensive information on types of inputs (exogenous) and outputs (endogenous) of the different tools, the underlying algorithms applied, the order of use (including potential iterative steps and gap filling steps), which organisation is responsible for which step, to what extent models are run based on similar techno-economic input data, etc. TSOs, for example, provide electricity and hydrogen demand data based on ETM, and electricity generation capacities data to ENTSOs for use in PLEXOS. It is unclear to what extent these inputs are also partially adapted by optimisation process in PLEXOS.

At this moment, it is difficult to obtain the full picture of the toolchain as information seems not fully complete and/or is scattered over various documents.

The TSOs have been trained to use the ETM to supply their national data. For the TYNDP Scenarios 2028 cycle, **SRG would request that the ENTSOs share their data collection template and instructions to TSOs in advance**, so that the process would be clearly understood and documented, and also that in the future, the SRG and other stakeholders would be able to comment on them. Such documentation would also improve the stakeholders' ability to comment when the ETM is used. Furthermore, SRG would like to point out the general shortcomings of the ETM – its developers claim that ETM is "open source", however, how the model works and which assumptions are taken across the different sectors is not very transparent and is hard to follow. This fact should trigger general discussion about the modelling suite applied for the TYNDP scenarios.

SRG underscores that although the TYNDP scenarios overall aim to comply with the EU energy and climate goals – and distinct topics and modelling issues have received attention – in the absence of full access to transparent documentation, it has been challenging to examine assumptions across topics. This lack of clarity makes it more difficult for stakeholders to assess where the key gaps are and where more dedicated thematic focus needs to be placed. Consequently, **improvement in the documentation of assumptions, also across all specific topics, is recommended for the next scenario cycle(s)**.

Interlinked Modelling Framework

The SRG was requested to provide feedback on the draft Interlinked Modelling (ILM) report. Although the ILM is not formally a part of the TYNDP scenario process, the SRG shared its comments[7] ahead of the ILM submission to ACER and the European Commission by the ENTSOs at the end of October 2025. The SRG members appreciated the opportunity to give feedback on the draft ILM progress report, even if the short deadline made it difficult to provide more than high-level comments, which can be found below:

- The SRG noted that clarification of terminology, in line with regulatory and framework guidelines requirements, would be a useful starting point to the report.
- More importantly, the SRG believes the goal of the ILM should remain: to move towards proper cross-sectoral integration and joint analysis across vectors.
- It would be illustrative and beneficial to discuss in the report any current limitations of the TYNDP process, and to better highlight already achieved benefits from the ILM process.
- The SRG further recommends clarifying how the ILM process or framework relates to the Innovation Roadmap for the TYNDP. It is important to avoid overlaps through better coordination, and it might be useful to integrate the two processes.
- The ILM process should include a systematic review and reuse of existing (open-source) models and frameworks already capable of cross-sectoral optimisation across multiple energy vectors.
- It would be very useful to see a comparison of ILM against current energy modelling tools, to assist in a systematic illustration of capabilities and limitations[8].

Gap-Filling Methodology

"Gap-Filling" refers to the step, within the TYNDP scenarios methodology, the purpose of which is to align the country-specific demand data collected bottom-up from TSOs with EU 2030 and 2050 goals, as specified in the ACER Scenario Framework Guidelines. Gap-Filling is primarily

[7] https://www.entsos-tyndp-scenarios.eu/wp-content/uploads/2025/10/TYNDP_2026_SRG_recommendations_on_the_ILM_161025.pdf
[8] .See also the Section on benchmarking against other scenarios.

done through demand reduction applied to certain energy carriers, namely solid fossil fuels (lignite and coal) and liquid fossil fuels (crude oil and petroleum products).

The SRG considers the potential impact of this process particularly relevant to the alignment of the TYNDP with EU decarbonisation ambitions. However, the current process of demand reduction creates a risk that Europe is underpreparing for the infrastructural requirements of the future energy system. Thus, five recommendations were delivered to the ENTSOs for the 2026 cycle.

Feedback from the SRG addressed consistency issues in the current Gap-Filling Methodology, which allows for demand destruction by not complementing reduction in Final Energy Consumption (FEC) from specific carriers and sectors with corresponding increases in substitute demand areas (such as electrification of transport). Addressing this critical element should be possible through the Energy Transition Model (ETM), a tool already employed for demand data collection. Such a methodological change, while still leaving space for transparency, could also be used to introduce a more reasonable consideration of further target years (2040 and 2050) and a fairer distribution of FEC reductions across Member States, according to the national contributions recommended by the European Commission.

The Gap Filling Methodology so far focused on the energy efficiency target. SRG points out to the need of learning whether a gap-filling step is executed or would be required for other targets such as the CO_2-targets (55% reduction in 2030, 100% reduction in 2050) and the target of reaching a minimum of renewables in the energy system. And if yes, what is the role of PLEXOS in estimating whether these targets are reached or not.

A concrete implementation of SRG recommendations would turn the Gap-Filling Methodology from a pure compliance exercise into a pre-modelling step, the outputs of which would have, as reasonably expectable, an impact on the results of the TYNDP analysis.

DEMAND

Reference Heat Demand Data in the Energy Transition Model (ETM)

Several issues were identified in the reference heat demand data used in the Energy Transition Model (ETM). The reference year used is 2019, which is relatively far off for a scenario that will be published in 2026. In addition, the data lack recent real-world heating demand profiles. These inconsistencies in the baseline heat demand figures could influence heating projections across the scenarios. ENTSOs were responsive to the concerns raised and facilitated discussions with the ETM developer, Quintel, to review the issue in detail. Due to timing constraints within the current TYNDP 2026 Scenarios cycle, the corrections identified by the SRG could not be implemented, however, ENTSOs have agreed to address them in the upcoming TYNDP cycle.

The representation of Europe's building stock also requires improvement. Current modelling insufficiently distinguishes between new/renovated and non-renovated buildings, despite their different heat demand and input energy demand profiles. This gap could affect downstream assumptions, including on heat pump performance. For example, the coefficient of performance (COP) formulas, do not differentiate efficiency below and above 7°C, and between regions, limiting the accuracy of heat pump deployment estimates. Such inaccuracies could result in an overestimation of heat pump deployment, leading to an underestimation of electricity demand for heating and the required infrastructure. Incorporating clearer building categories, distinguishing between regions (where required temperature differs), and making temperature-sensitive COP calculations based on real life performance of current heat pump models[9], are recommended for the next TYNDP 2028 scenarios cycle. If available, the draft National Building Renovation Plans (Art. 3 of the Energy Performance of Buildings Directive, EPBD, and respective guidance) could serve as a basis / bottom-up approach.

[9] Taking into account new heat pumps are more efficient than old ones and maintain high COP at below freezing temperatures.

Electric Vehicle (EV) Modelling

The electric vehicle (EV) modelling approach applied in the TYNDP 2026 cycle has insufficiently reflected the rapid evolution of electric mobility. Assumptions such as a fixed 50% share of inflexible charging, a constant 70% home / 30% street-charging split, and the treatment of fast charging only within the inflexible load do not fully capture expected developments in smart charging, vehicle-to-grid (V2G) and public charging infrastructure. Heavy-duty trucks and buses, as electrified, are included only implicitly in the electricity load, total demand is represented, but their distinct charging patterns, operational constraints, and flexibility options are not modelled. Such an approach can lead to misestimation of peak loads, undervaluation of demand-side flexibility, and distorted investment signals for generation, storage, and network capacity. ENTSOs have introduced more flexible national trajectories for EV flexibility in the 2026 cycle, while other structural refinements are planned for the updates in the upcoming 2028 TYNDP cycle.

ENTSOs have committed to revisiting several of these aspects in future updates, particularly around more granular fleet segmentation, integration of heavy-duty vehicles and improved treatment of fast and ultra-fast charging as infrastructure expands. Smart charging and ToU (Time of Use)-based optimisation are already embedded in the model structure, but further enhancements should be explored as EV penetration grows. While fleet segmentation has been addressed in the TYNDP 2026 cycle to some extent, and the integration of heavy-duty electric trucks is planned for inclusion in the TYNDP 2028 cycle, other recommendations on EV modelling have been included in the SRG's feedback to the Innovation Roadmap. Therefore, it would be efficient for all of these recommendations to be considered jointly in the 2028 TYNDP cycle, aiming at coherence and efficiency in implementation.

Additionally, ENTSOs expressed openness to collaborating with SRG on research examining alternative demand-side futures, including scenarios with lower energy demand for transport due to improved uptake of public transport, thereby decreasing the energy system cost.

Transparency of Demand Projection Assumptions

Finally, the documentation of demand assumptions and primary model inputs need to be more transparent and detailed. Other European-wide scenario exercises, such as the CLEVER

(Collaborative Low Energy Vision for the European Region) scenario by négaWatt, provide clearer explanations of input data and methodological choices (see: documentation). The SRG recognises that the demand projections in the TYNDP scenarios are supplied by national TSOs based on NECPs (National Energy and Climate Plans), which themselves are sometimes not fully quantified or documented transparently, resulting in gaps in transparency of methodology and result interpretation. Many times, TSOs might have to fill these gaps. This practice should be improved with a consistent, transparent and well documented methodology to fill the gaps.

To summarise, enhancing transparency in the TYNDP scenarios demand assumption documentation would improve usability, interpretability, and stakeholder confidence. Therefore, the SRG recommended ENTSOs the following to improve the documentation and transparency of the TYNDP demand modelling:

Recommendation 1: Each modelling step for both the reference demand and the projected demand is described and documented as comprehensively as possible, including all input data and parameter selections. All sources should be appropriately and accurately referenced.

Recommendation 2: Where feasible, assumptions and results are crosschecked against available publications and models, and the corresponding documentation is provided to ensure full transparency.

Flexibility as a bridge between supply and demand

Several flexibility potentials appear to be less explored or only partially represented in the current TYNDP Scenarios framework, notably industrial demand, electric heat pumps, and emerging loads such as data centers. Following topics seem to be the most prominent for further research:

- **Industrial demand:** A simplified level of flexibility seems to be assumed, but it is not clearly defined at sectoral or technological level.
- **Heat pumps:** contrary to fuel switching capability offered by hybrid systems, the demand-side flexibility potential from electric heat pumps is not taken into account. This could be included in the next Innovation Roadmap.

- **Data centers:** Given their expected significant growth in electricity demand, they may require specific treatment in demand modelling, including exploration of whether certain categories could provide flexibility.
- **Modelling clarity and transparency:** It is understood that flexibility potentials at the demand side are assessed at the demand level together with the demand side development. It is expected that in PLEXOS, the flexibility needs are matched with the flexibility solutions, finding a cost-effective mix of flexibility options at both the demand side and supply side (e.g., investment in and operation of storage at the supply side versus investments in oversizing at the demand side to be able to provide flexibility). It is not fully clear whether the flexibility potentials and associated costs at the demand side are implemented in PLEXOS, and compete with flexibility at the supply side. SRG is interested in learning more about this process.

SRG would welcome continuing this discussion in the 2028 TYNDP cycle to better understand and further refine the approach.

SUPPLY

Hydrogen (H2)

In the 2026 TYNDP cycle, the SRG was informed and consulted about the hydrogen supply methodologies by the ENTSOs in two areas: 1) Hydrogen Methodologies; and 2) Hydrogen import methodology, Import routes and potentials.

The former quantifies the volume of green hydrogen that can be produced from renewable sources in Europe. In the electricity market it reveals the amount of renewable energy diverted to (green) hydrogen, and consequently, the remaining renewable energy available to the grid. The hydrogen import methodology, on the other hand, models hydrogen imports based on inputs from TSOs via pipelines or ships.

Feedback on H2 Methodologies

The SRG requested substantially clearer explanations and additional detail across multiple components of the hydrogen modelling methodology presented by ENTSOs. The feedback highlighted difficulties in interpreting the 2026 typology, the need to explain the interaction between methodologies, and concerns about zone delineation, demand splits, and the underlying assumptions. Further clarification was requested on node granularity, synthetic fuel stoichiometry, Power Purchase Agreements (PPAs) versus dedicated RES categories, storage characteristics, pipeline flow constraints, price-formation logic, and electrolyser parameters.

Feedback on the H2 Import Methodology

The SRG indicated that the import methodology description was insufficient for understanding key assumptions, requesting clearer delineation between TSO-provided data and modelled results, as well as justification for the categorisation of import routes. Major concerns included the rationale for fixed versus flexible contract volumes, transparency on long-term contract assumptions, treatment of project-based import potentials, and the linkage between import modelling and intra-European topology. The SRG also questioned the pricing approach – particularly the exclusion of electricity costs – and sought explanations for cost differentials among import routes, safeguards against circular hydrogen flows, and methods for validating TSO-submitted data. Additional clarity was also requested on ammonia supply assumptions and how they influence market dynamics.

While the ENTSOs responded in some detail to the questions posed by the SRG, the hydrogen modelling methodologies included in the consultation package in July 2025 remained largely the same. This indicates that SRG's feedback was not effectively taken into account at this stage of the process. **SRG recommends that for the upcoming 2028 TYNDP cycle, these questions, needs, and improvements will be recognised and implemented by ENTSOs**, also considering that they have been included in the SRG's feedback on the Innovation Roadmap.

Commodity prices

Within the modelling exercise behind the 2026 TYNDP Scenarios, the SRG considers commodity prices, especially for fossil fuels and carbon dioxide, as key inputs.

Before a series of exchanges and consultations with the SRG, ENTSOs were proposing the IEA's "Announced Pledges Scenario" (APS) as the main source for European commodity prices projections for target years 2030 and 2040. The SRG recommended, instead, to refer to estimates presented in the European Commission's "With Additional Measures" (WAM) scenario.

First, the position of the SRG sought to guarantee higher compliance with ACER Scenario Guidelines (Article 23), which clearly indicate that the TYNDP scenarios should consider the latest Commission scenarios (whose content was not publicly available yet at the time of data collection, but had been discussed between ENTSOs and the EC).

Second, the SRG sees the EC WAM scenario data as a more loyal representation of single countries in the National Trends Scenario, due to a higher alignment to Member States' NECPs and a better incorporation of storylines, with fossil fuel prices mostly increasing from 2030 to 2040 in national outlooks, as opposed to what was shown in the IEA's APS.

Commodity prices recommendations from the SRG were openly accepted and implemented by the ENTSOs and are currently reflected on the input datasets for the TYNDP 2026 Scenarios model. More details are available in existing SRG Recommendation on Commodity Price Projections.

Other key issues

Other issues discussed by the SRG within the frame of supply-related topics, to which feedback was provided to the ENTSOs participating in the meetings, while not resulting in formal outputs:

- Biogas and biomethane production potentials in the EU Member States
- Demand-side flexibility of Electric Vehicle charging
- Demand-side flexibility offered by electric heat pumps

CARBON BUDGET

A specific working group was providing inputs on the carbon budget methodology for the TYNDP 2026 scenarios, also considering the relevant feedback from the ESABCC[10].

In the 2026 TYNDP scenarios cycle, in the context of the methodology determining the carbon budget (set to 16 Gt_$CO_{2\text{-eq}}$ in the period 2030-2050[11]), SRG's feedback focused on several aspects listed below. This feedback and recommendations were shared during dedicated meetings, e-mail exchanges and workshops, and not in a separate dedicated document that was voted upon.

SRG underlined the need to streamline definitions between Carbon Capture and Storage (CCS) and Carbon Capture and Utilisation (CCU) and Carbon Dioxide Removal (CDR) (what is captured, what is stored), clarify emission factors for solid biomass, discuss the addition of upstream emissions from fuel value chains (i.e., not only combustion), present emission avoidance through CCU without risking any double counting effect, avoiding double counting with regards to bioenergy and land use, define CCS in a way that it does not appear automatically as negative emissions or synonym to CDR.

Furthermore, SRG members pointed out that ENTSOs should ensure that quantitative values on CCU, CCS, CDR are not primarily based on gap filling methodology to reach the envisaged carbon budget, but are either directly modelled or retrieved from already existing modelling activities (e.g., Impact Assessment for the 2040 climate target). In the datasets, ENTSOs should share references where the quantification of CCU/CCS at EU, national or sectoral level is provided.

SRG recommends that the ENTSOs also introduce non-energy related emissions (i.e., industrial emissions from the ETS activities) in the carbon budget methodology, as this inclusion would allow for a better and more complete representations of the emission pool. This

[10] https://climate-advisory-board.europa.eu/reports-and-publications/towards-climate-neutral-and-resilient-energy-networks-across-europe-advice-on-draft-scenarios-under-the-eu-regulation-on-trans-european-energy-networks

[11] https://eur-lex.europa.eu/resource.html?uri=cellar:6c154426-c5a6-11ee-95d9-01aa75ed71a1.0001.02/DOC_5&format=PDF

could be addressed by providing references/statistics for quantification and projections of those emissions. Finally, **SRG suggests considering emissions from the aviation and maritime sectors**.

The SRG will also monitor to which extent the new Methodology Report[12] of the IPCC on CDR, CCS ad CCU expected in 2027 will have an impact on the estimation of the carbon budget and how this can be incorporated in the 2028 TYNDP cycle.

SUMMARY & OUTLOOK

The SRG would like to express our appreciation for the opportunity to participate in the 2026 TYNDP Scenarios process and to contribute with our knowledge and perspective throughout its development. It has been a valuable experience to observe and engage with the work as it progressed, and we commend the progress achieved. The SRG is grateful for the openness and responsiveness demonstrated by the ENTSOs throughout the process, which allowed for the building a trustworthy relationship, increased transparency and mutual understanding.

At the same time, it is important to underline that further improvements in the TYNDP process and the upcoming (and future) TYNDP cycle are necessary to ensure the effectiveness and reliability of the process going forward. Next to thematic recommendations shared in separate documents and further advice included in this opinion, we find the establishment of a clear and structured timeline essential to enable timely feedback and meaningful engagement. Without this, the quality and impact of contributions risk being diminished. In this context, it is also crucial that the high level of transparency is maintained, and in certain activities and topics even further enhanced, as highlighted throughout this text.

The SRG remains fully committed to addressing these areas and is ready to work collaboratively to strengthen both the process and its outcomes in the 2028 TYNDP cycle. We look forward to the possibility of continued and fruitful collaboration in the future, building on the positive experience reflected in this work.

[12] https://www.ipcc.ch/site/assets/uploads/2025/11/Decision-6-MR-CDR.pdf

STAKEHOLDER REFERENCE GROUP FOR THE TYNDP SCENARIOS

Stakeholder Reference Group Members*

Stakeholder category (Art. 12(3) of the TEN-E)	Entity represented	Member name
Convenors		
Other organisations	Renewables Grid Initiative	Andrzej Ceglarz
Other organisations	Ember	Elisabeth Cremona
Vice-Convenors		
Supply-side operators	WindEurope	Vasiliki Klonari
Members		
Associations involved in the electricity market	Eurelectric	Abi Afthab Olikathodi
Associations involved in the electricity market	International Hydropower Association	Brandon Marler
Associations involved in the electricity market	Energy Storage Europe	Daniel Vig
Associations involved in the gas market	Gas Infrastructure Europe (GIE)	Timo Cordeiro Gerres
Associations involved in the gas market	Eurogas, GD4S, GEODE, CEDEC	Martin Kaspar
Associations involved in the gas market	Hydrogen Europe	Isabel Alcalde
Associations involved in the gas market	European Biogas Association	Herman Dekker
Carbon capture/ storage/ utilisation	CO2 Value Europe	Anastasios Perimienis
Civil society representatives	Climate Action Network (CAN) Europe	Thomas Lewis
Civil society representatives	Bellona	Ganni Vasallo
Civil society representatives	Regulatory Assistane Project (RAP)	Zsuzsanna Pato
Energy consumers associations	IFIEC Europe	Lasse Torgersen
Organisations involved in energy efficiency solutions	International Council on Clean Transportation	Hussein Basma
Organisations involved in energy efficiency solutions	CurrENT	Christian Kjaer
EU DSO Entity	EU DSO Entity	Stephan Gross
Heating and cooling	European Heating Industry	Giuseppe Lorubio
Independent experts	Open Energy Transition	Daniel Rüdt
Independent experts	Agora Energiewende	Megan Anderson
Independent experts	TU Delft	Machteld van den Broek
Supply-side operators	EUTurbines/EUGINE	Theofilos Abraham
Supply-side operators	T&D Europe	Alexandre Oudalov
Other organisations	négaWatt	Nicolas Taillard

*At the time when this document was voted upon, i.e., 4.05.2026.