Annex 1 Stakeholder engagement

Question 5: Stakeholder Engagement Satisfaction

Feedback (Germanwatch)

It would be great if in the future the storyline development could be done in a more integrative process with stakeholders, instead of ENTSO-E and ENTSOG developing a storyline between them and then have it consulted.

Response

Thank you for your comment. Stakeholders were indeed deeply involved in the process from the beginning. Firstly, individual stakeholders were consulted to ensure plausible and up-to-date assumptions for technology and energy carrier development. A full list of these bilateral meetings is available on the Scenarios website. ENTSO-E and ENTSOG also developed key storyline parameters on the results of the public Storyline Consultation in autumn/winter 2020.

Feedback (WindEurope)

The perception is that many of the considerations and recommendations provided by relevant stakeholders during the different consultations remain often largely unaddressed.

Response

We are happy to address specific concerns on specific topics and look forward to your detailed comments on where exactly stakeholder engagement could be improved.

Feedback (Enel SpA)

The perception is that many of the considerations and recommendations provided by relevant stakeholders during the different consultations remain often largely unaddressed. There are some answers in the draft report but a more dedicated “one by one” approach would benefit transparency of the process.

Response

We are happy to address specific concerns on specific topics and look forward to your detailed comments on where exactly stakeholder engagement could be improved.

Feedback (EU DSO Entity)

ENTSO-E has presented the main conclusions of the draft scenario report ahead of its publication which improves the visibility on the process and its overall understanding. However, a deeper involvement of DSOs (including through DSO organizations) in this process should be allowed and taken on board as DSOs role is getting bigger in near future. In this aspect, the ongoing revision of the TEN-E regulation will have its paramount influence on the scope of further stakeholders' involvement and on the TYNDP governance.

Finally, while cooperation with DSOs on the TYNDP report is still quite recent, the Scenario Report should provide a reference to the upcoming substantial investment needs at distribution level, from two reasons:
• DSO grid must cope with the increasing constraints linked to having the majority of decentralized renewable energy sources connected at lower voltage levels,
• DSO must integrate such sources (technically, data, use of DER possibilities etc) with its grid

Response

We absolutely agree that the future EU DSO entity should become a more detailed participant in future TYNDP scenario development. At present, in the absence of such an entity, we have attempted to engage with representatives of the EU DSO networks. In future, we look forward to a more formal cooperation.

Feedback (CAN Europe)

Although CAN Europe generally welcomes the openness as well as the high level of transparency of the stakeholder engagement process, we have to highlight specific hurdles of non-profit civil society organisations such as CAN Europe in view of contributing to the process. The limited capacities within our membership make it difficult to provide detailed expertise at every step of the scenario building process. In contrast with stakeholders from the industry, CAN Europe is not dealing with the technicalities of planning electricity transmission networks and gas transmission networks on a daily base.
In order to allow for civil society organisations to engage more proactively in this debate, ENTSOs have already made important progress. We would like to reiterate our suggestions to offer introductory webinars for stakeholders that are entering the scene. It also would help to provide more regular updates about the progress of the TYNDP scenario building, for instance through the ENTSOs' newsletters. In addition, we suggest to publish clear timelines of the TYNDP process to allow for timely preparation and engagement of our member organisations. The Scenario Building Guidelines document goes into the direction of the manual that we have requested at the occasion of previous consultations.
While we understand that ENTSOs increased their direct exchange with industry groups to improve the scenario building on district heat, hydrogen and other areas, we would have seen this exercise as an opportunity to run a peer-reviewed process with independent researchers. Although the technical knowledge of industry federations is valuable, such input could have further increased the impartial character of the TYNDP scenario building process.

Response

We also addressed these concerns at the beginning of this TYNDP Scenario Report cycle. In order to facilitate easier access to the scenario building process, we undertake the following measures:

- Organising a "Kickoff Webinar" outlining key topics and the timeline for development whilst also asking stakeholder for live feedback via the Slido app (which we subsequently answered).
- Offering all participants the opportunity for bilateral exchanges, such as those documented on the Scenarios website.
- Ensuring two full six-week public consultation periods including a public consultation webinar to answer questions and update on the process.

Feedback (Eurelectric)

Eurelectric welcomes the efforts made by ENTSO-E and ENTSOG to ensure an inclusive and transparent TYNDP process. We are actively engaged to provide the power sector's view and contribute to the multiple consultation channels developed by the ENTSOs.

In line with their regulatory obligations, Eurelectric encourages the ENTSOs to maintain and strengthen the extensive consultation process involving all the relevant stakeholders, market players, national regulatory authorities and other public authorities.

Eurelectric welcomes the presentation by the ENTSOs of the draft scenario report during several informal bilateral meetings, ahead of its publication and during the consultation process. This approach improves the stakeholder's visibility on the procedure and its overall understanding. The public release of numerous data and different materials supporting the draft scenario Report is a also going into the right direction.

Going forward, Eurelectric supports the thorough revision of the governance for the elaboration of the TYNDP engaged in the ongoing revision of the TEN-E Regulation. This will ensure a coordinated, cost-effective and future-proofed approach to both electricity and gas infrastructure requirements and associated investments. It will also ensure that solutions proposed took advantage of synergies between sectors so as to ensure a resilient and economically optimal suite of possible solutions.

In particular, Eurelectric recommends the following:
• Maintain and continuously reinforce the direct involvement of the relevant stakeholders all over the process – i.e. drafting of the energy system wide cost benefit analysis (CBA), TYNDP scenario building but also for the infrastructure Gaps identification reports.
• With regards to DSOs 'involvement, and since integration of systems is not limited to the TSO level, there is a need for a greater role of DSOs in the TYNDP process. DSOs should be closely involved into the development of the TYNDP scenarios and in the selection of PCIs, starting from the scenario building exercise. DSOs have an overview on the sources connected to their grid (EV, DER, heat pumps) as well as technologies that will provide flexibility to the energy system (batteries, networks digitalisation, Demand Side Response, Power-to-gas and other...) DSOs can provide useful assumptions as regards peak demand and the impact of flexible demand.
• While allowing an extensive involvement of all relevant stakeholders throughout the entire TYNDP process, the ENTSOs should ensure consistency with existing processes pertaining to DSO / TSO

coordination existing at national level to avoid any duplication of work.
• Ensure a closer oversight from the European Commission and ACER to make certain that scenarios are based on electricity and gas demand forecasts which are compliant with the Paris Agreement, in close cooperation with the relevant stakeholders. The objective of the TYNDP scenario exercise is to provide bases for an efficient expansion of energy infrastructures. Therefore, we would support more visible cooperation with the Commission in the field of scenario building, ensuring all technical resources are targeted to climate objectives and are fully compatible with narratives defining likely outlooks for the EU.

Response

Regarding stakeholder engagement in the CBA methodologies and infrastructure gaps assessments, we thank you for your message but underline that the scenarios are developed separately and with different personnel than develop the CBA methodologies and infrastructure gaps assessment.

Regarding DSO engagement, we absolutely agree that the future EU DSO entity should become a more detailed participant in future TYNDP scenario development. At present, in the absence of such an entity, we have attempted to engage with representatives of the EU DSO networks. In future, we look forward to a more formal cooperation.

Regarding oversight from ACER and the European Commission, a dialogue between us and both organisations already exist via the TYNDP Platform. Both institutions are updated regularly on developments and latest results via bilateral meetings and both institutions provide feedback. We regret that, at the request of the institutions, we are unable to publish their detailed responses to our feedback. In the future, as now reinforced by the new TEN-E Regulation, ACER will also have a more visible role in developing the scenarios as they will also be responsible for the drafting of Framework Guidelines at the beginning of the process.

In order to make sure that our scenarios are compliant with the Paris Agreement, we benchmark our scenarios against the EC Impact Assessment.

Feedback (EDF)

EDF welcomes this joint ENTSO-E/ENTSO-G exercise as it makes sense to elaborate joint scenarios for electricity and gas with view to the decarbonisation objectives of the whole EU economy.
The main objective of the TYNDP is indeed to identify the investments needed in infrastructures. This is in particular important as the energy transition 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 option.
EDF considers that the TYNDP's scenarios envisaged do not meet these objectives. Firstly, the scenarios are not enough contrasted. Indeed, the two scenarios are based on a strong development of the hydrogen produced from decarbonized power but there are many uncertainties concerning the development of hydrogen (storage capacities, renewable capacities for electrolysers…). In case of less ambitious development of hydrogen, the TYNDP does not seem to identify alternatives and consequent network requirements. Secondly, the robustness, the sustainability and the consistency

of each scenario is quite questionable, especially with regard to the figures used. For example, for France, the capacities of solar and wind (onshore and offshore) needed to produce the hydrogen are higher than the potential identified by RTE or ADEME.
Therefore, EDF cannot be satisfied with the scenario building process.

Response

We like to point out that the demand and supply of hydrogen differs a lot from one scenario to another. Most hydrogen uptake is foreseen in Global Ambition. National Trends explores a lower trajectory, which is less than one third of the (2040) demand in Global Ambition. Differentiation may vary from one country to another. We also like to point out the 2050 hydrogen production in all scenarios is similar or below the level observed in the impact assessment. This is also shown in the benchmark section of the report.

The updated scenario report uses different trajectories for renewable electricity generation resulting into a lower onshore wind capacity. In any case Distributed Energy and Global Ambition do not intend to duplicate nationally developed scenarios. The mentioned studies refer to scenarios and not potential. Considering both the higher electricity production need and the European optimisation of the production mix, France appears as a net exporter in both scenarios.

Feedback (DUH)

Although DUH generally welcomes the openness as well as the high level of transparency of the stakeholder engagement process, we have to highlight specific hurdles of non-profit civil society organisations such as DUH in view of contributing to the process. The limited capacities within our membership make it difficult to provide detailed expertise at every step of the scenario building process. In contrast with stakeholders from the industry, DUH is not dealing with the technicalities of planning electricity transmission networks and gas transmission networks on a daily base.

In order to allow for civil society organisations to engage more proactively in this debate, ENTSOs have already made important progress. We would like to reiterate our suggestions to offer introductory webinars for stakeholders that are entering the scene. It also would help to provide more regular updates about the progress of the TYNDP scenario building, for instance through the ENTSOs' newsletters. In addition, we suggest to publish clear timelines of the TYNDP process to allow for timely preparation and engagement of our member organisations. The Scenario Building Guidelines document goes into the direction of the manual that we have requested at the occasion of previous consultations.

While we understand that ENTSOs increased their direct exchange with industry groups to improve the scenario building on district heat, hydrogen and other areas, we would have seen this exercise as an opportunity to run a peer-reviewed process with independent researchers. Although the technical knowledge of industry federations is valuable, such input could have further increased the impartial character of the TYNDP scenario building process.

Response

We also addressed these concerns at the beginning of this TYNDP Scenario Report cycle. In order to facilitate easier access to the scenario building process, we undertake the following measures:

- Organising a "Kickoff Webinar" outlining key topics and the timeline for development whilst also asking stakeholder for live feedback via the Slido app (which we subsequently answered).
- Offering all participants the opportunity for bilateral exchanges, such as those documented on the Scenarios website.
- Ensuring two full six week public consultation periods including a public consultation webinar to answer questions and update on the process.

On your proposal to offer dedicated "introductory webinars" for civil society stakeholders, we are very interested to follow up on this idea and include it in future processes. Thank you.

Feedback (Gas Distributors for Sustainability)

Despite the fact that there is not a gas DSOs entity in place, a deeper and specific involvement of gas DSOs in the consultation could have been organised and incorporated in the process.

Response

We absolutely agree that the future EU DSO entity should become a more detailed participant in future TYNDP scenario development. At present, in the absence of such an entity, we have attempted to engage with representatives of the EU DSO networks. In future, we look forward to a more formal cooperation.

Feedback (Eurogas)

The process was organized according to the rules of the gas and electricity regulation. It should be noted that there is a big difference in the involvement of the gas and electricity DSO. Due to the changes of the electricity regulation in 2018 the electricity DSO are directly involved in the process where as the DSO in gas are inly considered as "normal" stakeholders. This will hopefully change after the gas package is delivered. We think it is important that even before the new gas regulation will be finalized – probably in 24 – gas DSO will have the same level of involvement as the electricity DSO.

Response

We absolutely agree that the future EU DSO entity should become a more detailed participant in future TYNDP scenario development. At present, in the absence of such an entity, we have attempted to engage with representatives of the EU DSO networks. In future, we look forward to a more formal cooperation.

Feedback (Edison S.p.A)

Edison welcomes the efforts made by the ENTSOs to ensure an inclusive and transparent TYNDP process, in particular involving all the relevant stakeholders during the whole process and taking into account the feedbacks that have been sent. It is important to keep on improving based on the feedback received. It guarantees transparency and reliability to the whole process.

Response

Thank you. We will try to continue this development in future cycles.

Feedback (Anonymous)

More transparency and consultations are needed early in the process where the involvement of stakeholders is key

Response

We are happy to address specific concerns on specific topics and look forward to your detailed comments on where exactly stakeholder engagement could be improved. Regarding public consultations, we are happy to hear how we could further improve the format and content of the two six-week public consultations and the numerous additional webinars with stakeholder feedback that we already hold.

Question 10: Workshop Format Satisfaction

Feedback (Germanwatch)

We could not make it to the workshop.

Response

A link to a video of the workshop is available on the Download page of the scenarios website including the workshop presentations and the participant Q&A.

Feedback (EU DSO Entity)

DSOs were not sufficiently involved in the scenario building. It is important to note that most of the new energy sources will be connected to the DSO grid, creating significant challenges for its operation. It is imperative for the future to involve distribution operators in the development of the scenarios as well as to better reflect the role they have to play.

Response

We absolutely agree that in the future the EU DSO entity should be closely involved in future TYNDP scenario development. At present, prior to the establishment of the EU DSO entity, we have

engaged with representatives of the EU DSO networks. In the future, we look forward to a more formal cooperation.

Feedback (EDF)

The Q&A session is a great opportunity for stakeholders to express their views on the findings of the report. Though the timing doesn't allow to cover all the questions, it would be very welcome if you could publish a document with the questions and answers the days following the work shop.

Response

Thank you. Because we always receive more questions than the time allows to answer, we publish all questions subsequently with dedicated answers. These answers can be found on the Download page of the Scenarios website.

Feedback (Gas Distributors for Sustainability)

The workshop did not allow us to fully understand the rationale of several major assumptions and the way the energy system integration will be modelized, especially the optimisation of the total investment by minimising the cost of energy transition. The way the scenarios impact the distribution level is not sufficiently presented and assessed. The sector coupling does not seem complete and fully consistent.

GD4S will share a complete list of remark in the coming weeks.

Response

Thank you for sharing this information. We will look into how to better incorporate the distribution level in future workshops.

Feedback (Orsted)

Webinar provided a good review of the results and was a good opportunity to ask questions. Due to time limitations not all questions got answered, we have not been able to see that replies to these have been provided afterwards. It would also have been good to receive a copy of the presentation. But generally, it was well executed and structured.

Response

Thank you. Because we always receive more questions than the time allows to answer, we publish all questions subsequently with dedicated answers. These answers can be found on the Download page of the Scenarios website.

Feedback (Eurogas)

During the workshop the details concerning the modelling of gas market and infrastructures could have been more detailed. In addition, we think that for sector coupling more information would be needed on the fundamental models and effects that sector coupling could have on the electricity and gas.

Response

We note that this comment has been delivered by multiple stakeholders and we will look into how to better incorporate these elements in future workshops.

We would like to underline that the scenarios do not conduct an infrastructure assessment. This is part of the subsequent TYNDPs for electricity and gas.

Feedback (ENGIE)

From the perspective of a market player active on the energy markets (electricity and gases), we believe that the workshop did not provide relevant elements on the modelling of gas markets and infrastructures (especially in comparison to the electricity market). In addition, when it comes to sector coupling, the workshop did not explain how the fundamental models on the electricity and gas sides could really impact and feed off each other.

Response

We note that this comment has been delivered by multiple stakeholders and we will look into how to better incorporate these elements in future workshops.

Feedback (Edison S.p.A.)

Edison appreciates the possibility to attend public webinars, and to have access to the presentations in the following days.
Edison also appreciated the unformal presentations that has been proposed at association level improving the stakeholder's visibility on the process and its overall understanding. Useful and timely done.

Response

Thank you. We are open to answering any questions that stakeholders have – also outside of the public consultation periods – and we are happy to conduct bilateral meetings with any stakeholders who require more detailed exchanges.

Feedback (BDEW)

BDEW did not participate in the scenario workshop

Response

A link to the video of the workshop is available on the Download page of the scenarios workshop including the workshop presentations and the participant Q&A.

Question 12: Satisfaction with the format and level of explanation in the Scenario Report

Feedback (Fortum Power and Heat Oy)

The naming of the reports is unclear. What is meant by "Draft Scenario Building Report"? Concerning the main TYNDP 2022 Draft Scenario Report, the format of the report is clear and informative. However, especially in estimating the possibilities of both intermittent RES resources and of flexible resources, more information would be needed on the hourly price profiles and the price levels that each technology would receive from the market. With this information it would be possible to estimate the future possibilities of each technology better than based on average annual marginal prices only. The graph presentation in the report could also be better aligned so that the scenarios are in the same order in all graphs.

Response

Thank you for pointing out this typing error. We will address this.

We have received similar feedback from other stakeholders regarding hourly data. The electricity hourly profiles have been published as part of the updated Scenario Report and are available in the Download section of the scenarios' webpage.

Feedback (Germanwatch)

In general, we are satisfied. With regard to specific issues we would have been happy to receive more detailed information. We will report on this below in this questionnaire.

Response

Thank you for your comment. Please refer to the other annexes for our responses to your other comments.

Feedback (WindEurope)

There is still not sufficient detail on the reasons to choose "winners & losers" among decarbonisation technologies. Cost-efficiency considerations in the report are a black box and rather a consequence of the scenario's storylines than a cause for optimisation of the model. A comprehensive analysis of overall system costs and investments breakdown would help to better understand the cost-efficiency and economic implications of the scenarios proposed.
This results in scenarios that are rather often non-aligned to European Commission PRIMES scenarios.

Another missing link is the nexus between the scenarios and their possible implications in networks development. It would be highly desirable that the report provides a first sensitivity on which

implications each scenario has for the future development of electricity and gas networks in Europe and infrastructures related to imports from third countries, particularly for gas.

Response

For more detailed information on the methodologies used, we encourage you to also read the Scenario Building Guidelines (also available for download on the Scenario website). This also includes an overview of the cost assumptions.

It is worth noting that we do benchmark against EC scenarios. This data is available in Chapter 6 of the Scenario Report.

Regarding the further TYNDP development, the scenarios will feed into the TYNDP process. The electricity and gas draft TYNDPs are expected to be published in Q3 2022 for public consultation.

Feedback (Enel S.p.A.)

Although acknowledging the effort made with respect to previous reports, there is still not sufficient detail on the reasons to choose "winners & losers" among decarbonization technologies. Moreover, cost assumptions and cost results motivating the choices made by the model are largely undisclosed, making cost-efficiency considerations in the report a black box and rather a consequence of the scenarios storylines than a cause for optimization of the model. A comprehensive aggregated analysis on overall cost and investments breakdown of the proposed scenarios for the entire energy system would help to better understand cost-efficiency and economic implication of the scenarios proposed. Results being rather often non-aligned to EC PRIMES scenarios is another source of perplexity.

The TYNDP 2022 scenario draft report also loses track of the link between energy consumption –in all its forms- and the associated energy infrastructures needed to convey such energy –particularly networks-. In our opinion, the most relevant part of the exercise are not the scenarios themselves, but rather how those scenarios impact and constrain networks developments across Europe. It would be highly desirable that the report provides with a first estimation on which implications each scenario has for the future development of electricity and gas network in Europe and infrastructures related to imports from third countries, particularly for gas.

Response

For more detailed information on the methodologies used, we encourage you to also read the Scenario Building Guidelines (also available for download on the Scenario website). This also includes an overview of the cost assumptions.

It is worth noting that we benchmark against EC scenarios. This data is available in Chapter 6 of the Scenario Report.

Regarding the further TYNDP development, the scenarios will feed into the TYNDP process. The electricity and gas draft TYNDPs are expected to be published in Q3 2022 for public consultation.

Feedback (EU DSO Entity)

We suggest also wider description of basic market changes in the energy sector, including flows of energy from distributed energy sources (bottom-up) and resulting from this increased role and new tasks of DSOs.

Response

The scenarios, using a country/bidding zone granularity, do not intend to capture the flows between transmission and distribution scales. It rather focus on the impact of many specific development occurring at distribution scale such as rooftop PV, prosumer batteries, demand shedding or V2G. Regarding other power generation or electrolysers, the scenarios do not intend to predefine the location of those assets on a given scale. It is likely to develop at transmission and distribution levels.

The 2024 edition will provide the opportunity of a deeper involvement of DSO experts that will support a better description of dynamics occurring at distribution level.

Feedback (Eurelectric)

With regards the format:
Eurelectric has noticed worthwhile improvements in the 2022 draft scenario building report compared to the previous version. The quality of the documents prepared by the ENTSOs stresses the efforts made to provide a balance between summarising the in-depth analysis of possible forecasts and the communication of clear messages. However, to make it even more user-friendly, we would like to share the following considerations:

- 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. This impacts on the overall understanding of the reports as it requires the reader to navigates between multiple deliverables (excel, visualization platform, guideline, main report).
- We suggest that it would be better to centralise more information directly on the visualization platform including all the graphs/figures from the report and guidelines.
- We also suggest wider description of basic market changes in the energy sector, including flows of energy from distributed energy sources (bottom-up) and resulting from this increased role and new tasks of DSOs.
- A Balance worksheet resembling the ones from PRIMES scenarios would be of help.
- Since most of the questions from the present consultation are related to specific points of the scenarios, we would welcome to bring together all relevant information from the multiple deliverables (figures, graphs, explanations) in a unique document to facilitate stakeholders' work.

With regards the level of explanation for the scenario results:

- The report contains many high-level elements on energy demand (electricity, methane, hydrogen) and on energy supply (electricity, gases, biomass, imports), but very few pieces of information on infrastructure (electricity, gas, hydrogen; transmission, distribution) whose development is inevitably linked under different modalities to the different scenarios, with also very different cost implications.
- Visibility on infrastructures (existing and new) is nevertheless essential to get a view on the actual feasibility of the scenarios, their cost implications, and of the underlying

infrastructure constraints (if any), especially in the scope of different scenarios set to test the resilience of the existing infrastructure.

- We would like to stress that market-driven activities are not in the scope of ENTSOs and that any assumptions of additional investments should not only be supported by a (political) vision, but also by appropriate investment frameworks (which would allow the required investment to be realised concretely).
  For instance, it could be interesting to understand how the conclusions could be impacted by any evolution of the bidding zones considered for the power sector (see Fig 3. jn the scenario building guidelines report) or whether/where structural congestions could stay/materialize/evolve.

With regards the level of explanation for the electricity cost:

- The report is only reporting on a weighted average of marginal prices of electricity. Usually, the marginal cost of energy is used when assessing the savings in energy costs made as fixed costs associated will not change with kWh volumes. But the fixed cost must be paid and represent the investment costs in network infrastructure and plant. Therefore, it would be interesting to explain in some details why this aggregated result should not be compared with real market data (simplified model compared to model used for market coupling, existence of different price zones, etc.) and which are the selection criteria for the technology cost and commodity price assumptions.
- As a matter of fact, the energy cost component in the electricity bill only represents on average about one third of the electricity bill for households throughout Europe. Clearly, this section gives a wrong message about the overall cost of the energy transition. It does not give a view on the other costs components beyond the commodity (networks tariffs at transmission and distribution levels, support mechanisms, etc.). Yet, the TYNDP exercise aims at identifying infrastructure gaps and the related network investments required. Incidentally, we would like to stress that grid operators are the best place to provide estimates on the network cost component and that the absence of such an element is therefore really surprising.
- Instead of reporting an approximative proxy of the cost of electricity, it would have been more interesting to report the energy system costs as a whole, split according to e.g. the value chains (generation/production, networks (transmission/distribution), additional support, taxes…; both for electricity and gases). For the credibility of the modelling exercise, it would be very welcome to see a close relation between energy mixes, technology cost, commodity prices and obviously infrastructures, beyond the scenario narratives.

With regards the level of explanation for the benchmarking:

- The exercise is not really detailed. Beyond the charts, the text provided is merely descriptive, but it does not discuss the fundamentals behind the differences.
- There is no benchmarking provided on infrastructures (electricity, gases).

Response

Many thanks for your detailed comments on formatting. We will look at how to incorporate the many good ideas in future.

Regarding the Visualization Platform, we would be keen to hear which data in particular could be added.

Regarding detailed information on infrastructure, we stress that the scenarios are not intended to illustrate infrastructure development in the future (for this the TYNDPs and national development plans provide information). For example, your comments on infrastructure congestion fall outside of the scope of the TYNDP scenarios but will be covered in the TYNDP.

Thank you for your detailed proposals on electricity cost illustration. We will look into how to incorporate these in the future. In the meantime, for more detailed information on the methodologies used, we encourage you to also read the Scenario Building Guidelines (also available for download on the Scenario website). This also includes an overview of the cost assumptions including commodity prices.

Feedback (EDF)

Regarding the format and level of explanation, EDF acknowledges the huge work the TYNDP exercise requires and the efforts to make the document as user friendly as possible. EDF noticed improvements in the 2022 draft scenario compared to the previous version. However, EDF regrets that the choice of some of the assumptions was not clarified and explained in further detail. For example:

- Residential heating: Market shares are set in a normative manner and that no cost reference comes to support the choices made. Similarly, in 2050, 10 to 20% of methane boiler persists in all countries without explanations.
- Industry: The final energy demand coming from industry has increased compared to the previous TYNDP without explanation.
- The final consumption is significantly higher than this one in the previous TYNDP without explanation.
- Hydrogen: Regarding hydrogen demand, scenario DE shows 140 TWh and scenario GA a 450 TWh demand in 2050 for residential customer. However, the market shares of heating do not mention hydrogen.

Response

Residential market shares are not a result of a cost optimisation but rather an extension of the scenario storylines publicly consulted in autumn/winter 2020 as part of the Storyline Report publication. Gas based technologies (boilers, hybrid heat pumps, etc) represent the sum of both methane and hydrogen. The split between both gases is provided in the final demand figures.

The TYNDP 2022 scenarios were designed to be comparable with the Impact Assessment with regard to final energy demand. However, some differences between sectors may apply. The next edition of the TYNDP scenarios will offer the opportunity to better reflect the decarbonisation roadmaps, for example regarding the industrial sector

Feedback (Ember)

The draft Scenario Report is a well-designed document which successfully condenses the vast information on the scenarios into short, informative pieces. However, Ember would like to draw attention to the following points:

- Data on total emissions and carbon intensity of electricity generation for the EU27 (section 4.4.4) do not appear to correctly correspond with the data on electricity generation by fuel source. Furthermore, the 2025 carbon intensity (279 gCO2/kWh) is higher than the historical points for 2019 and 2020 (253 and 231 gCO2/kWh, respectively).
- While acknowledging the modelling required to extend the National Trends scenario to 2040, it is disappointing that almost no quantitative information is provided at this draft stage. Given the significant implications of the National Trends for the PCI assessment, stakeholders should have the opportunity to provide their feedback on the full extent of the National Trends scenario.
- To understand the role of natural gas infrastructure under different energy pathways, it would be helpful if the charts and information presented in section 4.2.3 distinguishes between methane and hydrogen fired capacity and generation, in line with the following text of the same report: "there is a need to distinguish methane from hydrogen." Currently, the split between the two can only be seen in Figures 21 and 22, hidden within the full power generation mix.
- V2G batteries are included under the broader category of batteries. It is suggested that the former is split and featured separately in the report given key differences from large scale batteries in: (i) cost (ii) availability and (iii) policy implications.

Response

The TYNDP scenario modelling show indeed a higher carbon intensity for electricity in 2025 compared to the 2019 historical value. This may be caused by a number of reasons. Electricity demand has increased in the 2025 compared to the 2019 level. Furthermore, nuclear phase out may be partly compensated by higher dispatch of fossil generators. Additionally, the climatic assumptions in the modelling (wind speed, temperature, etc) differ from the 2019 situation.

Historical values are highly dependent on actual weather conditions and 2020 was deeply impacted by the COVID crisis. The present decades will face simultaneously an increased electrification and some nuclear phase-our policies that may lead to temporary increase of emissions.

Although we have included National Trends 2040 values for hydrogen and methane, we indeed could not yet provide a full dataset for electricity at draft scenario level. In the updated report the National Trends 2040 dataset was expanded.

In the scenario report the split between methane and hydrogen for power generation is illustrated in the gas demand sections. More detailed information on the different battery types was also added in the electricity supply section.

Feedback (Gas Distributors for Sustainability)

GD4S believes there to be insufficient information on the infrastructure situation, evolution, and constraints. The scenarios must have clear links with the grid operation and design as energy infrastructure sector is a strictly interrelated and capital-intensive activity. Infrastructure adaptation

must not be merely a modelling result of the scenarios, but also an input to the scenarios. The best approach would be an iterative process between the modelling and the assumptions of the scenarios (supply, demand, prices and infrastructure) to finetune the assumptions and optimise the results in terms of investments in the energy system in its entirety. As the TYNDP exercise is not a planification of the energy system but a TSO assessment of potential PCI, we believe a sensitivity analysis could be sufficient to avoid the results being dependent on using assumptions that could not integrate some infrastructure constraints or needs, especially at the DSO level.
The sensitivity analysis should allow to test the impact of key assumptions that are not sufficiently justified to clearly frame the boundaries of the modelling shaping all the results and the decarbonisation pathway and the associated risk of the transition. To mention a few of them: the renovation rate of building, the electrification of the passenger cars, the development path of power generation etc.

The current level of explanation does not allow us to positively confirm that the scenarios respect the principles of the energy transition with regard to two main pillars: affordability and security of supply. Having in mind that if one of the two failed, the decarbonisation will fail too. The way the requirement of flexibility needs is treated appears far too weak regarding the importance of the topic. Therefore, we would expect the scenarios to be associated to some costs (affordability) and to clear technical flexibility assessment (security of supply).

Response

For the Distributed Energy and Global Ambition scenarios, the deployment of generators as well as transmissions infrastructure capacity is based on an investment loop taking into account the LCOE, low and high trajectories for each technology. As this is a very time-consuming exercise, the use of sensitivity analyses is beyond the scope of the joint scenario building process.

At draft scenario level we not yet performed an adequacy assessment for electricity. In the updated report such an analysis was added. As a result of this assessment, additional (gas) peaking units and batteries were added to meet adequacy standards.

Feedback (Eurogas)

The report contains many high-level elements on energy demand (electricity, methane, hydrogen) and on energy supply (electricity, gases, biomass, imports), but very few pieces of information on the infrastructure (electricity, gas at transmission and distribution level). The benchmarking exercise is not really detailed. Beyond the charts, the text provided is merely descriptive, but it does not discuss the fundamentals. Given some significant differences with EC impact assessment scenarios, one may have expected more explanations and justifications. For instance, when we compare the Distributed Energy and Global Ambition scenarios with the EC scenarios:

- We notice that electricity demand is always higher in ENTSOs scenarios. NoAny explanation or critical review is provided.
- Some significant discrepancies on gas do exist – in particular with the methane demand and the conventional gas demand.
- These results deserve a detailed analysis which is currently absent. Thus, a clarification will be very much welcomed.

- There is no benchmarking provided on infrastructures (electricity, gases) and assessment of the constraints, limits and optimisation (impact ofthe number of EV or electric heat pumps on peak demand and system developments).
- The choice of technology already in the scenario setting in the heating sectors misses detailed explanations. Using heat pumps in unrenovated house is highly energy inefficient. We think it is important for the understanding of the numbers that renovation rates and depth of renovation in the countries are shown. And how the question of back-up scenarios are built in. Feb 2021 has shown how a dark windless time affects the system.
- It would be important for which countries heat pumps instead of CHP for district heating have been chosen and how this fits together with the strong need of local electricity production as means of system security of supply. If existing potential studies for environmental energy sources as rivers, lakes, geothermal etc. has been done this would be very important to be added to the data.

Response

We would like to underline that the scenarios do not conduct an infrastructure assessment. This is part of the subsequent TYNDPs for electricity and gas. As a result, our benchmarking does not address this topic directly.

While we recognise that the electricity demand is higher than in some EC scenarios, we draw attention to the fact that the EC scenarios were created prior to the most recent development in EU energy and climate goals.

We agree that detailed analysis at a member-state level would help to accurately determine environmental energy sources. However, such analysis goes beyond the scope of the TYNDP scenarios. Nonetheless, we are keen to explore existing studies and, where appropriate, incorporate their results into our work.

Feedback (Current Europe)

Although the Report correctly affirms the key importance of innovation, we are concerned that not enough attention is paid to its potential value to modernization of the electric grid itself. Indeed, innovative grid technologies are not discussed in the Report, nor does ENTSO-E's identification of system needs modelling take into account alternatives other than storage. Even if the TYNDP does not require ENTSO-E to take grid alternatives (e.g. dynamic line rating, modular power flow technology, and superconducting high voltage technology) into account (as the framework dates back to a decade before), we would urge ENTSO-E to be pro-active and to highlight the important role such solutions could play in meeting developing environmental compliance needs.

Response

The technologies used to expand the transmission capacity are not defined at Scenario Building stage, it may consist in new lines or smarter management of existing ones.

Feedback (ENGIE)

Scenario results

- The report contains many high-level elements on energy demand (electricity, methane, hydrogen, etc.) and on energy supply (electricity, gases, biomass, imports), but very few pieces of information on the infrastructure (electricity, gas; transmission, distribution).
- Visibility on the infrastructures (existing and new) is nevertheless essential to get a view on the actual feasibility of the scenarios and of the underlying infrastructure constraints (if any).
- We would like to stress that market-driven activities are not directly in the scope of ENTSOs and that any assumptions of additional investments should not only be supported by a (political) vision, but also by appropriate investment frameworks (which would allow the required investment to be realised concretely).
- For instance, it could be interesting to understand how the conclusions could be impacted by any evolution of the bidding zones considered (see Fig 3. in the scenario building guideline) or whether/where structural congestions could stay/develop/move.

The cost of electricity

- The report is only reporting on a weighted average of marginal prices of electricity. It would be interesting to explain in some details why this aggregated result should not be compared with real market data (simplified model compared to model used for market coupling, existence of different price zones, etc.)
- As a matter of fact, the energy cost component in the electricity bill only represents on average about one third of the electricity bill for households. Clearly, this section gives a wrong message about the cost of the energy transition. It does not give a view on the other costs components (networks at transmission and distribution levels, support mechanisms, etc.). Incidentally, we would like to stress that grid operators are the best place to provide estimates on the network cost component and that the absence of such an element is therefore really surprising.
- Instead of reporting an approximative proxy of the cost of electricity, it would have been more interesting to report the energy system costs (generation/production, networks (transmission/distribution), additional support, energy efficiency measures, … both for electricity and gases).

Benchmarking

- The exercise is not really detailed. Beyond the charts, the text provided is merely descriptive, but it does not discuss the fundamentals behind the differences. Given some significant differences with EC impact assessment scenarios, one may have expected further explanations and justifications. In other words, these results deserve a detailed analysis which is currently absent and some clarifications will be very much welcomed.
- For instance, when we compare the Distributed Energy and Global Ambition with the EC scenarios: (i) we notice that electricity demand is always higher in ENTSOs scenarios. No explanation or critical review is provided. (ii) some significant discrepancies on gas do exist – in particular with the e-methane demand and the conventional gas demand.
- Finally, there is no benchmarking provided on infrastructures (electricity, gases).

Response

Regarding detailed information on infrastructure, we stress that the scenarios are not intended to illustrate infrastructure development in the future. Instead, the TYNDPs and national development plans provide such information. As you pointed out, market design (including bidding zone evolution) fall outside of the scope of the TYNDP scenarios.

Thank you for your detailed proposals on electricity cost illustration that closely mirror those of some other stakeholders. We will look into how to incorporate these in the future.

Regarding benchmarking, thank you for your recommendation to include more justification of differences from EC impact assessment scenarios. We will bear this in mind in the future. We have deliberately avoided benchmarking infrastructure. It is not the goal of the scenarios to assess infrastructure needs. This activity is undertaken in the TYNDPs and infrastructure gaps assessment.

Feedback (Edison S.p.A.)

Edison noticed improvements in the 2022 draft scenario building report compared to the previous version (improved granularity along the timeline for example for energy import by energy vector). The quality and comprehensiveness of the documents prepared by the ENTSOs improved and it is appreciable to have a balance between key elements and in-depth analysis of possible forecasts.

Still, the number of documents is quite important and sometimes it can be difficult to understand which report is the more relevant to consult, and it becomes necessary to navigate from one document to another to be able to answer the questions. Maybe it could be useful to find a way to link the documents together or get a unique document with different parts with a comprehensive reference indexation.

Response

Thank you for your comments. We have also received feedback from other stakeholders that better integration/cross-referencing of the many documents is necessary. We will take this into account in future.

Question 14: Satisfaction with the format and level of explanation in the Scenario Building Guidelines

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Feedback (WindEurope)

Although detailed, it tends to be technical and complex. Guidance on how to browse through results in the data files would be useful. Balance worksheets resembling the ones from PRIMES scenarios and policy-related KPIs would be also of help.

Response

The proposal on balance worksheets in the style used by the PRIMES scenarios has been raised by several stakeholders. We will look into how to incorporate such a format in future.

Feedback (Enel S.p.A.)

Although detailed, it tends to be quite technical and complex. Some guidance on how to browse through results in the data files would be useful. Balance worksheets resembling the ones from PRIMES scenarios with figures and policy-related KPIs would be also of help.

Response

The proposal on balance worksheets in the style used by the PRIMES scenarios has been raised by several stakeholders. We will look into how to incorporate such a format in future.

Feedback (CAN Europe)

The Scenario Building Guideline is a very helpful and well-designed document. A number of elements however is not covered sufficiently in view of the relevance for the scenario building. For instance, we miss detailed assumptions on the costs of carbon capture and storage (CCS) technologies, an assessment of the required storage capacities and the infrastructure costs for transporting carbon to those potential storage sites.
We also wonder whether gas and electricity demands result from a cost-optimal investment modelling or are predefined in the ambition tool, taking over TSOs' calibration. In the latter case this might have led to the high demand for gaseous energy carriers.
Given that newly built nuclear reactors play a relevant role in the Global Ambition scenario, indicators for investment costs and potential upgrading costs should have been added with the same level of detail like for other electricity generation technologies.

Response

The use of CCS is based on publicly consulted storylines, not on cost optimisation. The data sources for these assumptions are cited in the Scenario Report.

We can confirm that electricity demand assumptions are pre-defined in the Ambition Tool. However, electricity generation assumptions are based on an expansion model that uses cost optimisation. Cost assumptions are listed in the Scenario Building Guidelines.

Feedback (Oeko Institut)

Thank you for the more detailed description of the ambition tool. But we still wonder, as already mentioned for the draft scenario 2020, that gas and electricity demand are predefined in the ambition tool and not resulting from a cost-optimal investment decision. This approach seems to result in a high gas demand. Which might also come from the 'calibration of the parameter by the respective electricity and gas TSOs' (p. 13).

Response

It is not the goal of the TYNDP Scenarios to create cost-optimal scenarios but rather to explore different pathways to support infrastructure development. The quantification of demand scenarios

is derived from the Ambition Tool based on storylines that were extensively consulted. Overall gas demand in the COP21 scenarios is comparable with levels observed in the EC Impact Assessment.

We can confirm that electricity demand assumptions are pre-defined in the Ambition Tool. However, electricity generation assumptions are based on an expansion model that uses cost optimisation. Cost assumptions are listed in the Scenario Building Guidelines.

Feedback (Eurelectric)

Eurelectric welcomes the publication of a Scenario Building Guidelines Report alongside the main report. The document provides additional background materials and contextual aspects to better understand the aggregated figures provided in the Scenario Report. It also better reflects the interactions of the power sector with other selected applications (electrolysis, prosumers, electric vehicles, district heating). Overall, it is a good summary at an advanced level for non-technical experts in modelling. In addition, we welcome that ENTSOs provides a clear explanation on how they have considered stakeholders' input to draft the scenario report (cf. the paragraph 1.3 "Summarizing the improvements").

We also gladly received the improvement compared to the methodology report provided in TYNDP 2020.

Although the report is a high-level description of the scenarios and their methodologies, we believe there is still room for improvements:

- While we welcome that ENTSOs have added an appendix dedicated to the investment costs for the various technologies, Eurelectric is still missing more details such as methodology for data aggregation.
- The value selection for technology costs and commodity prices across time requires further justification that a certain flexible link with scenario narratives.
- There is no evaluation on perspective needs of ancillary services in the future, being critical services to the operation of the electric grid this should be included, maybe with studies detailing the prospective growth of the different services and which technologies are expected to fulfill this demand.
- A comprehensive aggregated analysis on overall cost and investments breakdown of the proposed scenarios for the entire energy system would help to better understand cost-efficiency and economic implication of the scenarios proposed.
- The definition of certain specifics, for example the "market configurations" for hydrogen seem excessively elaborated while finally addressed through arbitrary criteria; in such cases more simple and transparent criteria (open perhaps to probability) may carry certain value.
- Additional work is still needed to catch the exact benefits of energy system integration for the consumers. What would be the sensitivity of the analysis to some parameters chosen (e.g. activation prices for vehicle-to-grid)? Which discount factor is used in the capacity expansion model (i.e. how is the increasing uncertainty weighted in the objective function)?

One should also make it clearer that modelling results are necessarily a simplification of reality. The complexities of some policies can only be captured in a stylised manner in modelling.

In particular, scenarios illustrate different pathways based on certain predefined assumptions fixed at some point in time, but which are inherently subject to changes (e.g. evolution in energy policies related to COP, actual investments/divestments by market players, etc.). Finally, scenarios results do not prescribe that the required levels could be achieved by Member States or by market players. Regarding Member States, the final outcome of the negotiations over the Commission's proposals (Fit for 55 package, upcoming H2 and gas market decarbonization package, etc.), transposition of directives and the governance process will likely lead to different results/achievements

Response

The TYNDP 2020 Scenario report brought valuable information about the amount of RES capacity to be developed to supply a growing hydrogen demand through electrolysis. However, stakeholders have pointed out that following editions should further investigate the interactions between energy carriers. The improvement of hydrogen and electrolysis modelling has been considered as a priority by ENTSOG and ENTSO-E for this scenario edition. Such improvements have materialized by the definition of a wide range of electrolysis configurations and the development of a hydrogen system on the medium and long term. We believe that this updated methodology is a clear improvement compared to the TYNDP 2020, However we will continue to improve our methodologies for future editions.

For the Distributed Energy and Global Ambition scenarios, the deployment of generators as well as transmissions infrastructure capacity is based on an investment loop taking into account the LCOE, low and high trajectories for each technology. As this is a very time consuming exercise, the use of sensitivity analyses is beyond the scope of the joint scenario building process.

The TYNDP scenarios are designed to support the infrastructure assessment in the electricity and gas TYNDPs. They explore different pathways to capture the relevant uncertainties. We fully agree that such scenario modelling can capture only a simplification of reality. Furthermore, ENTSOG and ENTSO-E have sought to avoid making political statements with these scenarios and, as far as possible, to anchor key parameters in widely accepted data and assumptions. The National Trends scenario exists within an input framework provided by official data sets (such as PRIMES) and official energy and climate policies from the EU Member States (the NECPs, hydrogen strategies, etc.). The goal of ENTSOG and ENTSO-E has been to maintain a neutral perspective to these inputs.

Feedback (DUH)

The Scenario Building Guideline is a very helpful and well-designed document. A number of elements however is not covered sufficiently in view of the relevance for the scenario building. For instance, we miss detailed assumptions on the costs of carbon capture and storage (CCS) technologies, an assessment of the required storage capacities and the infrastructure costs for transporting carbon to those potential storage sites.
Given that newly built nuclear reactors play a relevant role in the Global Ambition scenario, indicators for investment costs and potential upgrading costs should have been added with the same level of detail like for other electricity generation technologies.

Response

Taking into account that the decision of investing in new nuclear units is very much a political decision, the level of capacity has been defined ex-ante as stated in the Final Storyline report. Not being an investment candidates, there is no use of cost information for the scenario building.

The use of CCS is based on publicly consulted storylines, not on cost optimisation. The data sources for these assumptions are cited in the Scenario Report.

Feedback (Ember)

This report offers helpful insight into the process undertaken to develop the scenarios and provides a detailed description of the underlying assumptions. However, Ember finds the latter lacking in three, interlinked aspects relating to demand, and requests that more information/clarifications are included in the final version of the document on the following:

- Energy efficiency: Firstly, the draft Scenario Report places significant emphasis on the energy efficiency first principle but no information is provided in the Guidelines on how this factored into the development of the two top-down scenarios. Secondly, the draft Scenario Report indicates a significant impact of efficiency on total energy and electricity demand; however, the Guidelines are unclear on the assumptions taken in this regard. Reference is made to the POTEnCIA Central Scenario as the primary source for efficiency assumptions, but it unclear if this refers solely to the technical efficiencies of technologies or the specific pathways of technology switch and turnover set out in the POTEnCIA Central Scenario.
- Electrification and market shares: the assumptions informing the rate of electrification and market shares per technology are not provided. As electrification is a crucial aspect of the energy transition and will have a significant impact on future levels of demand (of various energy carriers) and thus, energy infrastructure, it is essential to understand the range of electrification rates foreseen by the ENTSOs for different sectors and the assumptions informing the evolution of technology market shares.
- Hydrogen: the draft Scenario Report shows an emphasis on indigenously produced hydrogen from electrolysis. However, the Scenario Building Guidelines do not provide information about the assumptions which allow the reader to understand this preference. While it is understandable in the Distributed Energy scenario due to its emphasis on autonomy, the reasons for the emphasis on indigenous, green hydrogen production in the Global Ambition scenario are missing. Given the significant impact of hydrogen production on electricity demand, including explicit information on the assumptions driving electrolyser capacity and consumption would substantiate the modelled production levels.

Ember is disappointed to note that the assumptions on carbon capture and storage (CCS) in both the Scenario Building Guidelines and the draft Scenario Report are rather basic, the capacity prescribed by assuming a fixed percentage of the global CCS capacity included in the IEA's Net-Zero Report. CCS has important implications on (i) the potential role of natural gas infrastructure in the energy transition and (ii) the massive carbon budget overshoot projected in both COP21 scenarios.

Response

Energy demand is estimated with the Ambition Tool, as explained in the scenario building guidelines. Country specific element are also incorporated based on feedback from our TSO members. Energy

efficiency as well as electrification rate can be observed in the final energy demand results as presented in the demand section of the report.

Market shares for different technologies like EVs and heat pumps are provided in the Visualisation Platform for all EU countries. Import potentials for hydrogen are also available. For an overview of the costs for the different hydrogen sources, we refer to chapter 4 of the scenario building guidelines.

For future editions of the TYNDP scenarios we aim to further improve our methodologies, tools and visualisations.

Feedback (Gas Distributors for Sustainability)

Additional work is required in terms of effective sector coupling and flexibility solutions under consumers perspective. The direct involvement of the DSOs in the exercise would contribute to a better appraisal of the complexity of the topic.

Response

The role of DSOs is something we have attempted to address in the 2022 scenario building process. Indeed, as outlined in the bilateral meetings table, the scenario building team met with a group of experts from the DSO networks on multiple occasions, starting at the very beginning of the process. For next scenario editions we will look at how to further incorporate this.

Feedback (Eurogas)

Additional work is required in terms of effective sector coupling and flexibility solutions under consumers perspective. The direct involvement of the DSOs in the exercise could contribute to a better appraisal of the complexity of the topic.

Response

The role of DSOs is something we have attempted to address in the 2022 scenario building process. Indeed, as outlined in the bilateral meetings table, the scenario building team met with a group of experts from the DSO networks on multiple occasions, starting at the very beginning of the process. For next scenario editions we will look at how to further incorporate this.

Feedback (ENGIE)

This document is a good summary at advanced level for non-technical experts in modelling. Although there have been improvements over the years, notably on the interactions of the power sector with other selected applications (electrolysis, prosumers, electric vehicles, district heating), we believe that additional work is still needed to catch the benefits of energy system integration for the consumers.

As the report is a high-level description, some important technical aspects are missing. For instance: what would be the sensitivity of the analysis to some parameters chosen (e.g. activation prices for

vehicle-to-grid) ? Which discount factor is used in the capacity expansion model (i.e. how is the increasing uncertainty weighted in the objective function) ?

One should also make it clearer that modelling results are necessarily a simplification of reality and the complexities of some policies can only be captured in a stylised manner in modelling. In particular, scenarios illustrate pathways based on certain predefined assumptions fixed at some point in time, but which are inherently subject to changes (e.g. evolution in energy policies related to COP, actual investments/divestments by market players, etc.). Finally, scenarios results do not prescribe that the required levels could be achieved by Member States or by market players. Regarding Member States, the final outcome of the negotiations over the Commission's proposals (For for 55 package, hydrogen and gas market decarbonization package, etc.), transposition of directives and the governance process will likely lead to slightly different results/achievements.

Rem: In Table 5, no unit is provided for CO2 emission factor

Response

For the Distributed Energy and Global Ambition scenarios, the deployment of generators as well as transmissions infrastructure capacity is based on an investment loop taking into account the LCOE, low and high trajectories for each technology. As this is a very time consuming exercise, the use of sensitivity analyses is beyond the scope of the joint scenario building process. The gas CBA methodology however includes sensitivity for some of the parameters.

The TYNDP scenarios are designed to support the infrastructure assessment in the electricity and gas TYNDPs. They explore different pathways to capture the relevant uncertainties. We fully agree that such scenario modelling can capture only a simplification of reality. Furthermore, ENTSOG and ENTSO-E have sought to avoid making political statements with these scenarios and, as far as possible, to anchor key parameters in widely accepted data and assumptions. The National Trends scenario exists within an input framework provided by official data sets (such as PRIMES) and official energy and climate policies from the EU Member States (the NECPs, hydrogen strategies, etc.). The goal of ENTSOG and ENTSO-E has been to maintain a neutral perspective to these inputs.

Thanks for pointing out the oversight in table 5. The relevant unit had been added.

Feedback (Edison S.p.A.)

Edison welcomes the increased level of detail and granularity with new data disclosed along the timeline (2030, 2040, 2050) and more detailed breakdown by energy vectors or by sectors for example.

We welcome the improvement compared to the methodology report provided in TYNDP 2020- Yet it could be interesting to have some graphs to show the scenario evolution and discrepancies with the previous version of TYNDP, regarding green gas production for example, to explain how the scenarios have evolved. It seems that the hydrogen part in the demand has increased, it would be interesting to have the quantification of the correction that has been made in each scenario.

Response

The updated scenario report contains a specific chapter on benchmarking. In this section comparisons are made with the draft scenarios for TYNDP 2022 and with the Impact Assessment from the European Commission. The figures used for these benchmark graphs are also available in Excel, which can be found in the download section of the scenario website. This document also provided further comparisons with the previous TYNDP 2020 edition.

Question 16 – Satisfaction with the Visualisation Platform and Datasets

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Feedback (Fortum Power and Heat Oy)

The visualisation platform gives valuable information and has clear improvements. However, besides annual values, also monthly and hourly data and marginal prices should be available.

Response

We have received similar feedback from other stakeholders regarding hourly data. The electricity hourly profiles have been published as part of the updated Scenario Report and are available in the Download section of the scenarios' webpage. The scenario report contains a specific chapter on the cost of electricity. Information on marginal prices can also be found here.

Feedback (Germanwatch)

We appreciate the idea of a visualisation platform.

However, the information provided is coarse in many regards. For hydrogen we would like more detailed supply data: with which technologies will the hydrogen be supplied? Also on the demand side: Which sectors use the hydrogen? Also for methane it would be great to see the demand by sectors. There is no graphic for biomass and biogas. The electricity demand graph is odd: What do the different colors stand for? The legend ist not meaningful for the non-modeler. Was industry looked at in final energy demand? It seems to be missing. Also there is no infomration on the decarbonizatin pathway.

Response

With the updated scenario report we have expanded the Visualisation Platform to offer further data granularity. Final demand is now shown per energy carrier per sector and per application. Industrial consumption (energetic and non-energetic use) is part of the final energy demand and is also shown.

Figures on methane supply can be found in the gas data section of the Visualisation Platform. This includes conventional, biomethane and synthetic methane production. Also, the hydrogen section of the platform was expanded to also provide more information on demand. Hydrogen supply is available on an EU-27 level in the scenario report.

Some categories in the electricity demand graph were renames for further clarification. Exact definitions of the different categories can be found in the scenario building guidelines report, which is available on the scenario website.

Feedback (WindEurope)

The data is a bit hard to use due to the constant EU-27 vs Europe filter that needs to always be re-applied.

Response

Thank you for this feedback. We will address this topic and try to improve the usability in this regard.

Feedback (Enel S.p.A.)

It has been a nice addition.

Response

Thank you for this feedback.

Feedback (CAN Europe)

We generally welcome the high level of data accessibility and the level of detail provided via the Visualisation Platform. The separate modelling for the gas and for the electricity sector however makes it difficult to directly compare indicators for specific countries and for the EU: While the modelling of the electricity side partly provides details for EU and non-EU countries, the gas side is limited to the EU27. As the previous TYNDP 2020 data featured aggregated EU28 data, understanding the evolution of the same indicators over two versions of TYNDPs becomes difficult.

It would have been helpful to integrate an option to compare the draft scenario data with previous TYNDP data and other relevant scenarios like in section 6 ('Benchmarking') of the Draft Scenario Report. The Visualisation platform does not allow to clarify which technologies supply which shares of hydrogen in the mix and which sectors in will consume it. CAN Europe generally advocates for covering all data related to EU energy infrastructure planning with an open data license to make data available for free re-use for all stakeholders.

Response

Regarding benchmarking with other scenarios, examples of this benchmarking are already given in the report. The figures used for the graphs in the report are also available in Excel, which can be found in the download section of the scenario website. This document also provided further comparisons with the previous TYNDP 2020 edition.

TYNDP 2022 scenarios cover the EU-27 region. However, some non-EU country data that was used in the electricity modelling was also published for transparency purposes. All data provided on the

scenarios' Visualization Platform is available for download with an open data licence. These data sets can be found on the Download page of the Scenarios website.

For future editions of the TYNDP scenarios, we continue to improve our methodologies, tools and visualisations.

Feedback (Oeko Institut)

It would be very helpful to offer the possibility to compare the results with previous TYNDPs and other relevant scenarios e.g. form EC.
Clear labelling of the data under an open data licence would be appreciated.

Response

Please note that the data in the Visualization Platform is entirely stored under an open data licence and available for download at the Scenario website download page.

Regarding benchmarking with other scenarios, examples of this benchmarking are already given in the report. The figures used for the graphs in the report are also available in Excel, which can be found in the download section of the scenario website. This document also provided further comparisons with the previous TYNDP 2020 edition.

Feedback (Eurelectric)

The publication of the Visualisation Platform and the corresponding data is a good step towards more clarity and transparency.

This first attempt provides an interesting conceptual tool, which should be further promoted and upgraded in the future.

Going forward, it would be highly relevant to dig more into the details. For instance:
• Provide more information on demand and the impact of flexible demand. This could be done via detailed data sets in xls. format provided especially for demand, generation, cross border capacities, etc. A visualisation by sector for (electricity) demand as well as further details on the assumptions (e.g. number of EVs, heat pumps for example) would
also have been appreciated. Moreover, information on the electricity demand for electrolysis should be added.
• Clarify whether figures are at transmission level with embedded generation already offset, or otherwise.
• Provide sources for the figures indicated in the graphs as this is currently missing.
• Provide additional information on costs - especially regarding decarbonised gases, CCS/CCU and biomethane and the initial impact in infrastructures deployment/repurposing.

Eurelectric also identifies some limitations in the tool:
• Only KPIs selected by ENTSO-E are outlined;
• There is no possibility to change the type of chart (e.g. from percentages/relative scale to

numbers/absolute scale);
• No possibility as well to add other scenarios/benchmarks;

We would recommend to centralise any figures/graphs, provided in the report and its guidelines, also in the Visualisation platform. Hence it will help the user to get all data centralised in one point in a user-friendly way.

Response

Thank you for your suggestions. We would like to point out that all Visualisation Platform data and report graphs are also available in Excel format. Relevant document can be found in the download section of the scenario website. Furthermore, with the updated scenario report we have expanded the Visualisation Platform to offer further data granularity. For example, regarding final energy demand which is now available per energy carrier per sector and per application. Electricity demand for electrolysis can be found in the electricity section of the Visualisation Platform, labelled electrolysis config 1-5.

For more detailed information on the methodologies used, we encourage you to also read the Scenario Building Guidelines (also available for download on the Scenario website). This also includes an overview of the cost assumptions. A list of references used in the scenario building can be found in the download section of the scenario website.

For future editions of the TYNDP scenarios, we continue to improve our methodologies, tools and visualisations.

Feedback (EDF)

EDF recognizes the work done by the ENTSOs to provide stakeholders with a large amount of data. However, some improvements could be envisaged:
- The raw data are provided without any explanation make it difficult to understand. An explanatory document or walkthrough would be welcome.
- Residential heating: The sum of market shares is not always equal to 100%.
- Industry: too few data are available. There are no market shares, no energy breakdowns and no costs provided for this sector.
- There is no breakdown by countries for imports
- Provide additional information on costs - especially regarding decarbonised gases, CCS/CCU and biomethane and the initial impact in infrastructures deployment/repurposing.
- ENTSOs should also publish the assumptions relating to the reference network.

Response

Thank you for your proposals.

With the updated scenario report we have expanded the Visualisation Platform to offer further data granularity regarding demand per energy carrier per sector and per application. Any inconsistencies in the market shares were also addressed. Hydrogen import supply potentials from extra-EU countries are also available on the platform. We also would like to point out that an excel with all figures used for the graphs in the report is available in the download section of the scenario website.

Demand in the end use sectors (for example industry) is not a result of a cost optimisation but rather an extension of the scenario storylines publicly consulted in autumn/winter 2020 as part of the Storyline Report publication. This also applies to CCS. For more detailed information on the methodologies used, we encourage you to also read the Scenario Building Guidelines (also available for download on the Scenario website). This also includes an overview of the cost assumptions, where relevant.

Regarding the explanations provided for the datasets, we hoped that the information on assumptions and methodology provided by the Scenario Building Guidelines document would suffice. We are happy to consider recommendations for how better to embed these two elements in future.

Feedback (DUH)

The DUH generally welcomes the high level of data accessibility and the level of detail provided via the Visualisation Platform.

The separate modelling for the gas and for the electricity sector however makes it difficult to directly compare indicators for specific countries and for the EU: While the modelling of the electricity side partly provides details for EU and non-EU countries, the gas side is limited to the EU27. As the previous TYNDP 2020 data featured aggregated EU28 data, understanding the evolution of the same indicators over two versions of TYNDPs becomes difficult.

DUH generally advocates for covering all data related to EU energy infrastructure planning with an open data license to make data available for free re-use for all stakeholders.

Response

The Visualisation Platform provides data both on country as well as on EU level. All data is also available in Excel format in the download section of the scenario website, which might aid further analysis by stakeholders.

TYNDP 2022 scenarios cover the EU-27 region. However, some non-EU country data that was used in the electricity modelling was also published for transparency purposes. All data provided on the scenarios' Visualization Platform is available for download with an open data licence. These data sets can be found on the Download page of the Scenarios website.

Feedback (Ember)

Ember welcomes the level of data accessibility and detail provided through the downloadable datasets and Visualisation Platform. However, we note several sections where the data portrayed in the draft Scenario Report (which was kindly made available to download) was inconsistent with that provided in the other downloadable spreadsheets e.g. power sector capacities.

In addition, to the clarify assumptions informing the scenarios and improve transparency, we request that the following data is added to the relevant datasets:
• Market shares of technologies in the industrial and transport sectors (currently only available for

the residential and tertiary sectors)
• Energy demand broken down by energy carrier for residential, tertiary and industrial sectors (currently only available for transport and all sectors combined)
• Hydrogen fleet capacity and generation (kindly refer to response in question 3)
• Capacity and dispatch of V2G storage, separate from the broad category of batteries (kindly refer to response in question 3)

Response

With the updated scenario report we have expanded the Visualisation Platform to offer further data granularity. Final demand is now shown per energy carrier per sector and per application. Also, the hydrogen section of the platform was expanded to also provide gas demand, including gas demand for power. Also, the scenario report offers more detailed information, for example on different battery categories.

Market shares for heat pumps are only considered for the residential and tertiary sectors. For other sectors (for example industry) we do not model heat pumps explicitly, but rather the market shares of energy carriers (electricity, hydrogen, etc) in the different processes. These relative shares can be observed in the final demand sections of the visualisation platform.

Feedback (Gas Distributors for Sustainability)

We would like to congratulate ENTSO-E and ENTSOG for publishing the documents on a dedicated website. It is very easy to read and navigate. We welcome the availability of data and document for downloading (Excel format). It allows to better compare ENTSOG scenarios with other EU scenarios. We believe it will be completed with additional information in the constant improvement process of the TYNDP. We would welcome for instance to find assumptions on cost reinforcement of the grids.

Response

Thank you for your feedback. We note that several stakeholders have shown an interest in benchmarking data over multiple scenario reports. We will try to incorporate this in future.

Feedback (Orsted)

The visualisation platform is a powerful tool and helps to better understand the data. It may be a bit burdensome to select EU 27, as one needs to deselect every individual country. Adding LCOE/LOOH calculations could also help. But in general, it is very welcome to have this tool. Moreover, the excel sheet with the numerous tabs is also extremely helpful.

Response

Thank you for your feedback. We will consider your comments on usability in the next iteration of the Platform. Levelised costs for electricity are provided in a specific chapter of the scenario report. Exact figures used in the graphs can be found in the download section of the scenario website.

Feedback (Eurogas)

Nevertheless, some areas of improvements are possible like adding the option to include other scenarios/benchmarks and harmonizing items on gas and electricity (for instance yearly peak and Dunkelflaute peak demand which are key for energy systems).

Response

The yearly, peak and Dunkelflaute demand are the specific cases used in the gas TYNDP infrastructure assessment. AS the electricity TYNDP does not use these cases, these are only provided for gas.

Regarding benchmarking with other scenarios, examples of this benchmarking are already given in the report. The scenarios are already benchmarked against the EC Impact Assessment.

Feedback (currENT Europe)

The data is a bit hard to use due to the constant EU-27 vs Europe filter that needs to always be reapplied.

Response

Thank you for your feedback. We will consider your comments on usability in the next iteration of the Platform.

Feedback (ENGIE)

We welcome the amount of information that has been put in the public domain via the visualisation platform. Nevertheless some significant improvements are needed:
- Inconsistency between datasets and the Scenario Report in some cases, as illustrated below in more detail.
- No possibility to change type of chart (from percentages/relative scale to numbers/absolute scale)
- No possibility to add other scenarios/benchmarks
- Need for harmonizing items reported on electricity and gases (for instance yearly, peak and Dunkelflaute peak demand, which are key for energy systems).
- Weird selection of items reported in the Tableau tools - Electricity: yearly demand (for 3 climate years) vs Gas: yearly/peak/Dunkelflaute demand

Response

Thant you for this feedback. For the upcoming scenario editions we aim to further improve the Visualisation Platform, taking your suggestions into consideration.

Each type of data on the Visualisation Platform uses specific unit types, which stem from the modelling tools used or the purpose in TYNDP. Market shares for mobility and heating technologies are expressed in percentage. Annual Energy consumption is expressed in TWh.

To build the scenarios for TYNDP 2022 the electricity market model was run for three different climate years, as is further explained in the scenario building guidelines. For transparency purposes, the dispatch results for all three climate years were published on the Visualisation Platform. The yearly, peak and Dunkelflaute demand are the specific demand cases used in the gas TYNDP infrastructure assessment.

Feedback (Bosch Thermotechnik)

The level of detail of the data is suitable, nevertheless a glossary explaining what the categories contain would be useful, for instance "hybrid gas" doesn't clarify whether H2 and methane based solutions are both covered or not.

Response

A hybrid heat pump uses electricity for most of the years and uses a gas for cold winter situations. For the market shares of hybrid heat pumps in the residential and tertiary sectors, the visualisation platform highlights which part of the heating is provided by both energy carriers. For the gas part, the split of hydrogen and methane is shown in the demand sections of the Visualisation Platform. Further clarification was added on the relevant sections of the platform.

Feedback (Edison S.p.A.)

The visualization platform is certainly a useful graphical tool to display the data. Some granularities could still be improved, for example in the case of hydrogen import the graph does not provide the breakdown by country.

We would recommend centralising any figures/graphs provided in the report and its guidelines also in the Visualisation platform since it will help the user to get all data centralised in one point in a user-friendly way.

Response

With the updated scenario report we have expanded the Visualisation Platform to offer further data granularity regarding demand per energy carrier per sector and per application. Hydrogen import supply potentials from extra-EU countries are also available on the platform. We also would like to point out that an excel with all figures used for the graphs in the report is available in the download section of the scenario website.

Feedback (Anonymous)

Please do check that values are consistent between what is in the report, visualisation platform and dataset

Response

Thank you for your feedback. We will review this data for consistency.