Annex 5 – Supply Ranges

Question 1: Wind Energy Ranges. The Storyline Report defined ranges for the share of wind energy in 2030 and 2050 based on stakeholder consultation feedback. Do you agree that these scenarios are consistent with the assumptions made in the Storyline Report?

Feedback (Germanwatch):

Resulting wind offshore numbers could have been expected to be even higher in the GA scenario.

Response:

The TYNDP 2022 Scenario Report consists of one central policy scenario (National Trends) that recognises national and EU climate targets as reflected in the latest Member States National Energy and Climate Plans and two COP21 Scenarios (Global Ambition and Distributed Energy) that complies with EU Climate Law ambition. All together the two COP21 scenarios aim to create contrasted scenarios with differentiated narratives and assumptions that project long-term demand and supply, explore uncertainties, and provide insight on challenges that energy infrastructure is facing during the energy transition.

For offshore wind in GA the capacity reaches the upper limit of the range we defined as part of the storyline report public consultation.

Feedback (WindEurope):

The values for wind capacity in the DE and GA scenarios in 2030 are in line with the EC's Impact Assessment that foresees 374 GW of onshore wind and 79 GW of offshore wind. However, onshore wind has very low capacity figures in GA in 2050 (around 650 GW), significantly lower than the Impact Assessment of the European Commission (1,000 GW) and lower than the minimum set in the TYNDP 2022 Storyline (around 800 GW). Offshore wind capacity for 2050 is in line with the 300 GW from the EC's Impact Assessment.
Load factor values are in line with WindEurope's statistics – which have an increasing trend due to the development of larger wind turbine models.
Lastly, we would also like to see the split of floating wind in the offshore wind figure.

Response:

The TYNDP 2022 Scenario Report consists of one central policy scenario (National Trends) that recognises national and EU climate targets as reflected in the latest Member States National Energy and Climate Plans and two COP21 Scenarios (Global Ambition and Distributed Energy) that complies with EU Climate Law ambition. All together the two COP21 scenarios aim to create contrasted scenarios with differentiated narratives and assumptions that project long-term demand and supply, explore uncertainties, and provide insight on challenges that energy infrastructure is facing during the energy transition.

Regarding wind capacity the Global Ambition scenario storyline focuses on offshore wind, whereas Distributed Energy focusses more on onshore. As a result the onshore wind figures in GA are lower then the level in the Impact Assessment.

Unfortunately, floating offshore wind has not been considered in the scenarios. We will try to incorporate this in the TYNDP 2024 scenario cycle.

Feedback (Enel SpA):

We have concerns about the excessively large volumes of offshore wind that the scenarios consider. 28% share by 2050 seems disproportionate, not only due to higher costs compared to onshore wind, but also due to the fact that many Member States have very limited potential for offshore wind. This is already recognized by relevant studies and analyses such as the JRC Enspreso database assessment. Therefore, we suggest to verify the feasible potential and do not overestimate the capacity of an overloaded European transmission network to transfer large volumes of RES-based electricity across Europe.

Response:

The TYNDP 2022 Scenario Report consists of one central policy scenario (National Trends) that recognises national and EU climate targets as reflected in the latest Member States National Energy and Climate Plans and two COP21 Scenarios (Global Ambition and Distributed Energy) that complies with EU Climate Law ambition. All together the two COP21 scenarios aim to create contrasted scenarios with differentiated narratives and assumptions that project long-term demand and supply, explore uncertainties, and provide insight on challenges that energy infrastructure is facing during the energy transition.

Based on the above, we have explored different levels of offshore wind capacity in the DE & GA scenario to show contrasted possible developments. These contrasted pathways are in line with the publicly conlsutated scenario storyline report.

Feedback (Climate Action Network (CAN) Europe):

The variation of the Global Ambition scenario and the Distributed Energy scenario values for 2030 in the TYNDP 2022 Draft Scenario Report is relatively small. Despite the increase compared to the range presented in the TYNDP 2020 scenarios, the two values are still situated at a relatively low level within the draft range of the TYNDP 2022 Storyline Report (but in line with the updated range). We would have liked to see how higher shares of domestic hydrogen production from dedicated offshore wind capacities potentially could ease transmission infrastructures, for instance though offshore wind farms producing hydrogen on energy islands or operating as offshore hybrid projects forming interconnectors.

Response:

The TYNDP 2022 Scenario Report consists of one central policy scenario (National Trends) that recognises national and EU climate targets as reflected in the latest Member States National Energy and Climate Plans and two COP21 Scenarios (Global Ambition and Distributed Energy) that complies with EU Climate Law ambition. All together the two COP21 scenarios aim to create contrasted

scenarios with differentiated narratives and assumptions that project long-term demand and supply, explore uncertainties, and provide insight on challenges that energy infrastructure is facing during the energy transition.

Energy islands and offshore hybrid wind farms are beyond the scope of the scenario report for this cycle. We will try to incorporate this in the TYNDP 2024 scenario cycle.

Feedback (Oeko-Institut):

The variation of the Global Ambition scenario and the Distributed Energy scenario values for 2030 in the TYNDP 2022 Draft Scenario Report is relatively small. Despite the increase compared to the range presented in the TYNDP 2020 scenarios, the two values are still situated at a relatively low level within the draft range of the TYNDP 2022 Storyline Report (but in line with the updated range).

Response:

The TYNDP 2022 Scenario Report consists of one central policy scenario (National Trends) that recognises national and EU climate targets as reflected in the latest Member States National Energy and Climate Plans and two COP21 Scenarios (Global Ambition and Distributed Energy) that complies with EU Climate Law ambition. All together the two COP21 scenarios aim to create contrasted scenarios with differentiated narratives and assumptions that project long-term demand and supply, explore uncertainties, and provide insight on challenges that energy infrastructure is facing during the energy transition.

Based on the above, we have explored different levels of offshore wind capacity in the DE & GA scenario to show contrasted possible developments.

Feedback (Eurelectric):

First of all, Eurelectric welcomes that ENTSOE has provided a clear distinction between onshore and offshore wind generation/capacity in its scenarios.

However, Eurelectric has identified some discrepancies between the figures provided on wind capacity in the Visualisation Platform on one hand and the Excel files on the other hand.

When looking at the figures from the Visualisation Platform, we note that DE scenario foresees a total capacity for wind by 2050 of 1 727, 452 GW (onshore: 1 296, 478 GW /offshore : 430, 974 GW) while GA scenario foresees a less ambitious evolution by 2050 with a total wind capacity of 1 377, 559 GW (including onshore: 828, 117 GW/Offshore : 549, 452 GW). At a first glance, the figures provided in the GA seem to be more aligned with Eurelectric forecasts as laid down in its most ambitious scenario in the "Decarbonisation Pathways' (total wind capacity of 1.110 GW by 2045 (643 GW for wind onshore and 467 GW for wind offshore).

But as a general comment, the power system resulting from TYNDP's assumptions is featured by a very high penetration of RES in both scenarios (over 65% in 2030 and even over 90% in 2050).
While we fully support to the largest possible extent the integration of renewable energy sources to reach the objectives of the Green Deal, we wonder whether the following elements have been considered and are properly reflected in both scenarios with regards the evolution of wind generation:

- *the potential for cost reduction over time for the wind power industry which may scale up this technology.*
- *Permitting procedures which are currently too lengthy and hampering the deployment of new power generation capacity and electric grids.*
- *The need to get an adequate grid expansion, both at transmission and distribution levels, which raises challenges from a cost and time perspective.*
- *The impact on the adequacy of the electricity system, considering the low levels of baseload and dispatchable generation (e.g. nuclear around 10% of generation in 2030 and between 1% and 5% generation in 2050, while gas represents 15% in 2030 and 5% in 2050)*
- *The role of hybrid offshore.*

Response:

Technology improvements, such as larger turbines, have been considered for future wind power generation, leading to increased efficiency. Regarding the adequacy of the electricity system, the report will detail the adequacy check that has been performed. Moreover, the updated version of the report will offer the opportunity to bring more detailed output on flexibility (including demand-side).

Energy islands and offshore hybrid wind farms are beyond the scope of the scenario report for this cycle. We will try to incorporate this in the TYNDP 2024 scenario cycle.

Feedback (EDF):

For 2050, for France, the onshore wind capacity reaches 175 GW in DE and 115 GW in GA which are much higher than the highest RTE's scenarios (about 75 GW in 2050). It is surprising to have such ambitious trajectories in the two scenarios as this would require a modification of the current regulatory framework and reinforced political support according to the actors. Moreover, it is worth considering the potential of wind capacity.
This remark also applies to the offshore wind capacity. In indeed, the scenario DE in 2050 foresees 90 GW of offshore capacity whereas as the maximum estimated by RTE reaches 65 GW.

Response:

The updated COP21 scenarios show a lower onshore wind capacity due to a more ambitious development of solar capacity in line with the Final storyline report. When comparing to RTE's scenario, it is key to take into account other factors such as:

- a much higher electricity demand triggered by electrolysis-based fuels
- the use of an optimisation of the European mix taking benefit from the French RES potential

As mentioned in the report highlights, we acknowledge that a change of societal, political and economic framework is necessary for scenarios to materialize.

Feedback (Gas Distributors for Sustainability (GD4S)):

"All the scenarios envisage a very significant generation from intermittent and variable sources. The flexibility needs seem covered by batteries and some DSM with apparently very low needs for dispatchable generation and back-up generation.

Under such assumptions, the electricity system's adequacy should be carefully assessed, in addition to the associated risks in sensitivity analysis as well as risk analysis. The way the system will operate under such model would require specific attention."

Response:

Regarding the adequacy of the electricity system, the report will detail the adequacy check that has been performed. Moreover, the updated version of the report will offer the opportunity to bring more detailed output on flexibility (including demand-side).

Feedback (Eurogas):

Based on data from the Data Visualization Platform (attention point: there are some discrepancies between them and the figures in the report), the power system resulting from TYNDP's assumptions is featured by a very high penetration of RES in both scenarios (over 65% in 2030 and even over 90% in 2050). Such values are very challenging for the adequacy of the electricity system, considering the low levels of baseload and dispatchable generation.

Response:

Regarding the adequacy of the electricity system, the report will detail the adequacy check that has been performed. Moreover, the updated version of the report will offer the opportunity to bring more detailed output on flexibility (including demand-side).

Feedback (currENT):

"The values for wind capacity are very good in the DE and GA scenarios in 2030. However, onshore wind has very low capacity figures in GA in 2050 (around 650 GW), significantly lower than the Impact Assessment of the European Commission (1,000 GW) and lower than the minimum set in the TYNDP 2022 Storyline (around 800 GW).
Load factor values are in line with our figures, however, we would also like to see the split of floating wind in the offshore wind figure."

Response:

The TYNDP 2022 Scenario Report consists of one central policy scenario (National Trends) that recognises national and EU climate targets as reflected in the latest Member States National Energy and Climate Plans and two COP21 Scenarios (Global Ambition and Distributed Energy) that complies with EU Climate Law ambition. All together the two COP21 scenarios aim to create contrasted scenarios with differentiated narratives and assumptions that project long-term demand and supply, explore uncertainties, and provide insight on challenges that energy infrastructure is facing during the energy transition.

Unfortunately, floating offshore wind has not been considered in the scenarios. We will try to incorporate this in the TYNDP 2024 scenario cycle.

Feedback (ENGIE):

"Based on data from the Data Visualization Platform (attention point: there are some discrepancies between them and the figures in the report), the power system resulting from TYNDP's assumptions is featured by a very high penetration of RES in both scenarios (over 65% in 2030 and even over 90% in 2050). While we fully support the higher decarbonization ambition set out in the EU Green Deal and in the subsequent legislative proposals, such values of RES-E are very challenging for the adequacy of the electricity system, considering the low levels of baseload and dispatchable generation (e.g. nuclear around 10% of generation in 2030 and between 1% and 5% generation in 2050, while gas represents 15% in 2030 and 5% in 2050).
Such levels of RES-E share are even more ambitious if we consider that the share of full electric heat pumps is very high in both scenarios, leading to an increased peak demand in the power system.
As already argued in the more general statements, we believe that there should be at least one more conservative scenario in terms of RES penetration to reflect the permitting hurdles and the challenges related to grid development. In the current "two scenarios" setting, we believe that Global Ambition could be more conservative to counterbalance the intrinsic uncertainty in the realization of the alternative Distributed Energy Scenario."

Response:

The TYNDP 2022 Scenario Report consists of one central policy scenario (National Trends) that recognises national and EU climate targets as reflected in the latest Member States National Energy and Climate Plans and two COP21 Scenarios (Global Ambition and Distributed Energy) that complies with EU Climate Law ambition. All together the two COP21 scenarios aim to create contrasted scenarios with differentiated narratives and assumptions that project long-term demand and supply, explore uncertainties, and provide insight on challenges that energy infrastructure is facing during the energy transition.

Regarding the adequacy of the electricity system, the report will detail the adequacy check that has been performed. Moreover, the updated version of the report will offer the opportunity to bring more detailed output on flexibility (including demand-side).

Feedback (Edison S.p.A.):

If we compare with other scenarios sources, the hypotheses of wind energy could be over-estimated, in particular in the DE scenario, which foresees for Italy a wind capacity of 87 GW, while 50 GW seems to be the maximum potential capacity (cf "Strategia Italiana di Lungo Termine sulla riduzione delle emissioni dei gas a effetto serra", published on sept 30th 2021, Paragraph 2.2.2).

Response:

The TYNDP 2022 Scenario Report consists of one central policy scenario (National Trends) that recognises national and EU climate targets as reflected in the latest Member States National Energy and Climate Plans and two COP21 Scenarios (Global Ambition and Distributed Energy) that complies with EU Climate Law ambition. All together the two COP21 scenarios aim to create contrasted scenarios with differentiated narratives and assumptions that project long-term demand and supply, explore uncertainties, and provide insight on challenges that energy infrastructure is facing during the energy transition.

Based on the above, we have explored different levels of offshore wind capacity in the DE & GA scenario to show contrasted possible developments.

Feedback (BDEW Association of German Energy and Water Industries):

"After incorporating the feedback from stakeholder consultation, the ranges for installed wind onshore capacities in 2030 and 2050 narrowed considerably compared to the draft storyline ranges. The resulting ranges seem realistic.
Yet, it is difficult to assess whether they are in line with the assumptions made in the Storyline Report."

Response:

We thank for your valuable feedback. In the updated scenario report we have added some comparisons with the storyline ranges in the Benchmark section, for example for wind capacity.

Question 2: Solar/PV. The Storyline Report defined ranges for the share of solar/PV energy in 2030 and 2050 based on stakeholder consultation feedback. Do you agree that these scenarios are consistent with the assumptions made in the Storyline Report? - Solar/PV range

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Feedback (Fortum Power and Heat Oy):

The difference in solar energy between DE and GA is too small. In the Storyline Report assumptions and feedback there is quite a big range for solar development which should be included in the scenarios. Higher solar development could happen e.g. with lower acceptance of wind power development or with more favourable solar cost development. More information would also be needed about the calculated price level that wind and solar generation receive from the market, as well as on the possibilities to combine solar generation with distributed storage and flexible demand.

Response:

The TYNDP 2022 Scenario Report consists of one central policy scenario (National Trends) that recognises national and EU climate targets as reflected in the latest Member States National Energy and Climate Plans and two COP21 Scenarios (Global Ambition and Distributed Energy) that complies with EU Climate Law ambition. All together the two COP21 scenarios aim to create contrasted scenarios with differentiated narratives and assumptions that project long term demand and supply, explore uncertainties, provide insight on challenges that energy infrastructure is facing during the energy transition.

Feedback (Germanwatch):

Ok, but resulting PV numbers could have been expected to be even higher than currently in the DE scenario.

Response:

The TYNDP 2022 Scenario Report consists of one central policy scenario (National Trends) that recognises national and EU climate targets as reflected in the latest Member States National Energy and Climate Plans and two COP21 Scenarios (Global Ambition and Distributed Energy) that complies with EU Climate Law ambition. All together the two COP21 scenarios aim to create contrasted

scenarios with differentiated narratives and assumptions that project long term demand and supply, explore uncertainties, provide insight on challenges that energy infrastructure is facing during the energy transition.

Feedback (Climate Action Network (CAN) Europe):

There is no variation of the Global Ambition scenario and the Distributed Energy scenario values for 2030 in the TYNDP 2022 Draft Scenario Report. Compared to the updated range of the TYNDP 2022 Storyline Report (up to 2,000 GW), the values for 2050 (987 GW to 1,110 GW) are both conservative. Our PAC scenario foresees up to 1,800 GW in the EU27 in 2050.

Response:

The TYNDP 2022 Scenario Report consists of one central policy scenario (National Trends) that recognises national and EU climate targets as reflected in the latest Member States National Energy and Climate Plans and two COP21 Scenarios (Global Ambition and Distributed Energy) that complies with EU Climate Law ambition. All together the two COP21 scenarios aim to create contrasted scenarios with differentiated narratives and assumptions that project long term demand and supply, explore uncertainties, provide insight on challenges that energy infrastructure is facing during the energy transition.

Following stakeholder feedback during public consultation we have adapted the solar PV capacities in the updated scenario report. The capacities in Distributed Energy were increased. The COP 21 scenarios now show a 35 percent difference for 2030. For 2050 the solar PV capacity was increased by 67 percent for Distributed Energy compared to the draft report. Resulting in a difference of 56 percent difference between both COP 21 scenarios in 2050.

Feedback (Oeko-Institut):

There is no variation of the Global Ambition scenario and the Distributed Energy scenario values for 2030 in the TYNDP 2022 Draft Scenario Report. Compared to the updated range of the TYNDP 2022 Storyline Report (up to 2,000 GW), the values for 2050 (987 GW to 1,110 GW) are both conservative.

Response:

The TYNDP 2022 Scenario Report consists of one central policy scenario (National Trends) that recognises national and EU climate targets as reflected in the latest Member States National Energy and Climate Plans and two COP21 Scenarios (Global Ambition and Distributed Energy) that complies with EU Climate Law ambition. All together the two COP21 scenarios aim to create contrasted scenarios with differentiated narratives and assumptions that project long term demand and supply, explore uncertainties, provide insight on challenges that energy infrastructure is facing during the energy transition.

Feedback (Eurelectric):

"Eurelectric notes that the difference between the two scenarios with regards solar capacity is very small. For instance, by 2030, the solar capacity for GA is 445 278 MW while for DE the solar capacity is 450 330 MW.

As stressed in our reply to question 23, the power system resulting from TYNDP's assumptions is featured by a very high penetration of RES in both scenarios (over 65% in 2030 and even over 90% in 2050).
While we fully support to the largest possible extent the integration of renewable energy sources to reach the Objectives of the Green Deal, we wonder whether the following elements have been considered and are properly reflected in both scenarios with regards the evolution of wind generation:

- *the potential for cost reduction over time for the solar power industry which may scale up this technology.*
- *Permitting procedures which are currently too lengthy and hampering the deployment of new power generation capacity and electric grids.*
- *The need to get an adequate grid expansion which raises challenges from a cost and time perspective.*
- *The impact on the adequacy of the electricity system, considering the low levels of baseload and dispatchable generation"*

Response:

The TYNDP 2022 Scenario Report consists of one central policy scenario (National Trends) that recognises national and EU climate targets as reflected in the latest Member States National Energy and Climate Plans and two COP21 Scenarios (Global Ambition and Distributed Energy) that complies with EU Climate Law ambition. All together the two COP21 scenarios aim to create contrasted scenarios with differentiated narratives and assumptions that project long term demand and supply, explore uncertainties, provide insight on challenges that energy infrastructure is facing during the energy transition.

The report will detail the adequacy check that has been performed.

Feedback (EDF):

"At European level, EDF notes that the difference between the two scenarios is very small (e.g., by 2030, GA @ 445 GW and DE @ 450 GW).
Furthermore, for France, both scenarios are based on the highest RTE's scenarios of PV development. These trajectories seem to be very ambitious and constitute an industrial challenge. A scenario with a PV development less ambitious should be envisaged."

Response:

The updated scenarios show an higher and more differentiated ambition in solar capacity already in 2030.

Carbon neutrality at European level is an ambitious target, it translated into ambitious trajectories for many technologies, RES in particular. While Global Ambition takes into account a wide range of generation (including new nuclear reactors) and focuses on offshore wind, it still has an electricity demand significantly higher than RTE scenarios. Such situation combined with the optimisation of the European mix taking benefit from favorable RES technical condition in France, does result in an ambitious PV capacity even in this scenario.

The need to change the current framework of RES development, among others, is higlighted in the Executive summary of the scenario report.

Feedback (Gas Distributors for Sustainability (GD4S)):

"(same as previous question)
All the scenarios envisage a very significant generation from intermittent and variable sources. The flexibility needs seem covered by batteries and some DSM with apparently very low needs for dispatchable generation and back-up generation.
Under such assumptions, the electricity system's adequacy should be carefully assessed, in addition to the associated risks in sensitivity analysis as well as risk analysis. The way the system will operate under such model would require specific attention."

Response:

The final report will detail the adequacy check. Moreover, the updated version of the report will offer the opportunity to bring more detailed output on flexibility (including demand-side).

Feedback (Eurogas):

All the scenarios envisage a very significant generation from intermittent and variable sources. The flexibility needs seem covered by batteries and some DSM with apparently very low needs for dispatchable generation and backups.

Response:

The final report will detail the adequacy check. Moreover, the updated version of the report will offer the opportunity to bring more detailed output on flexibility (including demand-side).

Feedback (ENGIE):

As already argued in our previous answer, we observe that penetration of RES in the power system is a very high in both COP21 compliant scenarios. While we fully support the higher decarbonization ambition set out in the EU Green Deal and in the subsequent legislative proposals, such values of RES-E are very challenging for the adequacy of the electricity system, considering the low levels of baseload and dispatchable generation. We believe that there should be an additional more conservative scenario reflecting the intrinsic uncertainty in the development of RES-E, which is especially high for smaller power plants such as solar PV. Alternatively, we believe that Global Ambition could be more conservative.

Response:

ENTSOG and ENTSO-E remain technology and energy carrier neutral while building the TYNDP scenarios. That is why Distributed Energy and Global Ambition explore different future pathways based on storylines. This also applies to the deployment of RES. Whereas Distributed Energy has a stronger focus on RES, Global ambition tends more towards a system where RES is complemented with energy from other sources, e.g., via imports. These storylines are the result of a public consultation.

Feedback (Edison S.p.A.):

The envisaged range is very large for energy supply at 2050, and it is difficult to comment the dynamic of development of solar energy supply.

Response:

The difference between both COP 21 scenarios follows the quantitative ranges consulted as part of the storyline report. This range reflect the high dependence on prosumer willingness to invest in solar panels and on new building policy such as mandatory PV installations.

Feedback (BDEW Association of German Energy and Water Industries):

After incorporating the feedback from stakeholder consultation, the ranges for installed Solar/PV capacities in 2030 and 2050 narrowed considerably compared to the draft story-line ranges. The resulting ranges seem more realistic but may be somewhat too low, tak-ing into account current studies e. g. for Germany.

Response:

We thank you for your valuable feedback.

Question 3: Nuclear Ranges. The Storyline Report defined ranges for the share of nuclear in 2030 and 2050 based on stakeholder consultation feedback. Do you agree that these scenarios are consistent with the assumptions made in the Storyline Report? - Nuclear Range

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Feedback (Germanwatch):

Total numbers seem to be consistent. However, the report mentions that there will be even newly built nuclear power plants in the GA scenario and that they are also considered being a flexible energy plant. This details would need further explanation.

Response:

The expansion of nuclear power generation in the Global Ambition scenario is in line with its storyline, which relies on a more diverse approach in terms of decarbonisation technologies. It also helps to cover the range of possible national policies. In addition, new reactors have been considered only in countries where actual projects exist, and no phase-out policy has been decided. The resulting level in 2050 is within the range of European Commission Impact Assessment scenarios.

The presence of a residual fleet of existing nuclear reactors in 2050 in Distributed Energy will give RES development more time to reach a fully renewable electricity system (if desirable) and by providing a low carbon flexibility source. Considering the benchmark with the EC Impact Assessment, nuclear capacity in Distributed Energy level is five times lower than the lowest EC Impact Assessment scenario while Global Ambition and REG scenarios see the same level.

Feedback (Oeko-Institut):

But we are not sure if the storylines are representing realistic assumptions regarding the future role of nuclear in the future electricity system and think that their share will decline significantly.

Response:

The prolongation of existing nuclear fleet and the construction of new reactors is an option kept opened in some Member States which goes beyond the sole power plant economics. The Global Ambition scenario reflects this situation while reflecting phase-out policies were decided and it only considers new reactors where such projects exist. Regarding the presence of a residual fleet of existing nuclear reactors in 2050 in Distributed Energy, it supports RES development by giving more time to reach a fully renewable electricity system if desirable and by providing a low carbon flexibility source at least at seasonal level through maintenance scheduling. Considering the benchmark with the EC Impact Assessment, nuclear capacity in Distributed Energy level is five time lower than the lowest EC Impact Assessment scenario while Global Ambition and REG scenarios see the same level.

Feedback (Eurelectric):

"Eurelectric welcomes TYNDP 2022 draft scenario report recognizes the role of nuclear as a non-emitting baseload provider and a support to the entire system reliability. However, both GA and DE scenarios foresee a declining nuclear capacity in Europe between 2030 and 2050 (from 97 to 86 GW in GA scenario and from 77 to 19 GW in DE scenario) whereas Eurelectric deep decarbonization scenario projects an increasing capacity (from 104 GW in 2030 to 121 GW in 2050).

Moreover, we would like to add that:

- *The storyline on nuclear should integrate more consideration regarding the permitting procedure for the development of nuclear power plants as well as their location.*
- *when comparing capacity and generation in each scenario on the draft Report, the resulting average running hours appear very low in both DE and GA scenarios (around 5.300 hours in 2030, around 3.700 hours in 2050). Such values appear unrealistic given the typical baseload functioning of nuclear technology and the low level of dispatchable generation estimated in the TYNDP scenarios."*

Response:

The prolongation of existing nuclear fleet and the construction of new reactors is an option kept opened in some Member States which goes beyond the sole power plant economics. The Global Ambition scenario reflects this situation while reflecting phase-out policies were decided and it only considers new reactors where such projects exist. Regarding the presence of a residual fleet of existing nuclear reactors in 2050 in Distributed Energy, it supports RES development by giving more time to reach a fully renewable electricity system if desirable and by providing a low carbon flexibility source at least at seasonal level through maintenance scheduling. Considering the benchmark with the EC Impact Assessment, nuclear capacity in Distributed Energy level is five time lower than the lowest EC Impact Assessment scenario while Global Ambition and REG scenarios see the same level.

Feedback (ENGIE):

"Based on data from the Data Visualization Platform (attention point: there are discrepancies between them and the figures in the report), the ranges provided for nuclear capacity in the Storyline report appear reasonable and capture the uncertainty about plans for decommissioning and new builts over the coming decades.
However, when comparing capacity and generation in each scenario on the Scenario Report, the resulting average running hours appear very low in both DE and GA scenarios (around 5.300 hours in 2030, around 3.700 hours in 2050).
Such values appear unrealistic given the typical baseload functioning of nuclear technology and also given the high penetration of renewables and the low level of dispatchable generation estimated in the TYNDP scenarios, and undermine the credibility of the scenarios."

Response:

The prolongation of existing nuclear fleet and the construction of new reactors is an option kept opened in some Member States which goes beyond the sole power plant economics. The Global Ambition scenario reflects this situation while reflecting phase-out policies were decided and it only considers new reactors where such projects exist. Regarding the presence of a residual fleet of existing nuclear reactors in 2050 in Distributed Energy, it supports RES development by giving more time to reach a fully renewable electricity system if desirable and by providing a low carbon flexibility source at least at seasonal level through maintenance scheduling. Considering the benchmark with the EC Impact Assessment, nuclear capacity in Distributed Energy level is five time lower than the lowest EC Impact Assessment scenario while Global Ambition and REG scenarios see the same level.

Feedback (BDEW Association of German Energy and Water Industries):

Germany will fade out its energy production from nuclear power plants by end 2022. The further development in other European countries will depend on policital decisions which are difficult to foresee. In particular, this includes whether taxonomy assumes nuclear as being sustainable.

Response:

We agree with your view that the prolongation of existing nuclear fleet and the construction of new reactors is an option kept opened in some Member States which goes beyond the sole power plant economics. The Global Ambition scenario reflects this situation while reflecting phase-out policies were decided and it only considers new reactors where such projects exist. In Distributed Energy, we see the presence of only a residual fleet of existing nuclear reactors in 2050.

Question 4: Hydrogen Ranges. Hydrogen: The Storyline Report gave an outlook of hydrogen sources available for each scenario. Do you agree that the hydrogen supply in these scenarios is consistent with the assumptions made in the Storyline Report? - Hydrogen Range

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Feedback (Fortum Power and Heat Oy):

The possibilities of green hydrogen production by the onshore wind resources in the Nordic countries and the transport of the produced hydrogen or synthetic fuels to Continental Europe could be considered more in the Distributed Energy scenario.

Response:

Based on your feedback, we have increased the H2 production from dedicated renewables, in part onshore wind. We will look further into the dedicated offshore installations for the TYNDP 2024 scenarios.

Feedback (Germanwatch):

The amount produced in the DE and GA scenarios do not differ much, although one could have expected higher production values in the DE scenario. Also it remains unclear, why blue hydrogen remains in the 2050 hydrogen mix in GA.

Response:

As a low carbon source, nuclear power also contributes to decarbonise the energy system through the production of blue hydrogen, especially in the Global Ambition scenario.

Feedback (WindEurope):

"There is a massive dependency on hydrogen imports by 2050 in the GA scenario (1,000 TWh) yet there seem to be small assumptions on H2 production from dedicated offshore installations. Already today, there are a handful of projects with dedicated electrolyser capacity from offshore assets including "NorthH2" (4GW dedicated capacity by 2030, 10GW dedicated capacity by 2040) or the 2 GW "SeaH2Land"
We disagree with the figures provided by ENTSO scenarios that suggest a deeper and broader use of hydrogen in all sectors. For the so-called "harder to abate" sectors such as certain industrial sectors (e.g. steel, cement, chemicals) or selected heavy-duty or long-distance transport segments, renewable hydrogen (i.e. hydrogen produced by electrolysis powered by renewable power) can play a key role in their decarbonization. Europe cannot afford to waste resources promoting hydrogen use in sectors where activities can be decarbonized at a lower cost with electrification."

Response:

Based on your feedback, we have increased the H2 production from dedicated renewables, in part dedicated offshore wind. We will look further into the dedicated offshore installations for the TYNDP 2024 scenarios. In our scenarios, we explore different possible pathways of the future energy system. In Global Ambition, the usage of hydrogen in all sectors represents one pathway to reach the decarbonisation targets while Distributed Energy relies more on an increased use of electricity.

Feedback (Enel SpA):

We disagree with the figures provided by ENTSO scenarios that suggest a deeper and broader use of hydrogen in all sectors. For the so-called "harder to abate" sectors such as certain industrial sectors (e.g. steel, cement, chemicals) or selected transport segments such as aviation or maritime, renewable hydrogen (i.e. hydrogen produced by electrolysis powered by renewable power) can play a key role for their decarbonization. Europe cannot afford to waste resources promoting hydrogen use in sectors where activities can be decarbonized at a lower cost with electrification.

Response:

In our scenarios, we explore different possible pathways of the future energy system. In Global Ambition, the usage of hydrogen in all sectors represents one pathway to reach the decarbonisation targets while Distributed Energy relies more on an increased use of electricity.

Feedback (Climate Action Network (CAN) Europe):

The Global Ambition storyline stresses the importance of digitalisation and automation. Under this headline, a broad deployment of demand side flexibility and direct electrification could be expected. Against this backdrop, the strong cross-sectoral emphasis on hydrogen beyond certain industry sectors and aviation does not appear to be fully consistent. Using hydrogen should not be considered as an aim in itself but as one storage technology amongst others that facilitates the increased integration of renewable energy sources.

Response:

Distributed Energy and Global Ambition explore different future pathways based on storylines. In the Global Ambition scenario, digitalisation and automation are drivers to strengthen the competitive position of the industry with an impact on demand. Hydrogen can be one of the means to address this.

Furthermore, the updated version of the report will offer the opportunity to bring more detailed output on flexibility.

Feedback (Agora Energiewende):

"The volumes for H2 expected by the ENTSOs (1750/2000 TWh in 2050, p. 21) is significantly above what many studies expect: 600-1000TWh, see page 14 in the H2 insights study: https://static.agora-energiewende.de/fileadmin/Projekte/2021/2021_11_H2_Insights/A-EW_245_H2_Insights_WEB_V2.pdf.

The Agora Energiewende no regret hydrogen study calculated a demand for 270TWh in 2050 for selected industry applications (https://static.agora-energiewende.de/fileadmin/Projekte/2021/2021_02_EU_H2Grid/A-EW_203_No-regret-hydrogen_WEB.pdf). Our future of fossil gas study calculated interim results amounting to 350TWh in 2050 for industry (https://static.agora-energiewende.de/fileadmin/Projekte/2021/2021_07_EU_GEXIT/AgoraEW_Phasing_out_fossil_gas_in_the_EU_Interim_Results_20211028.pdf) . Therefore, the suggested 650/750TWh in industry in 2050 seem too high (p. 21).

Agora Energiewende's study on a 2030 EU coal exit calculates that the full load hours of gas power plants in 2030 will be around 2000 (https://static.agora-energiewende.de/fileadmin/Projekte/2020/2020_09_EU_Coal_Exit_2030/A-EW_232_EU-Coal-Exit-2030_WEB.pdf see figure 9, page 25). Therefore, the suggested full load hours seem around 15% too high for 2030 (p. 30)."

Response:

The TYNDP 2022 Scenario Report consists of one central policy scenario (National Trends) that recognises national and EU climate targets as reflected in the latest Member States National Energy

and Climate Plans and two COP21 Scenarios (Global Ambition and Distributed Energy) that complies with EU Climate Law ambition. All together the two COP21 scenarios aim to create contrasted scenarios with differentiated narratives and assumptions that project long term demand and supply, explore uncertainties, provide insight on challenges that energy infrastructure is facing during the energy transition.

Feedback (Eurelectric):

"According to the final storyline report, in the GA scenario, hydrogen comes from a wider range of renewable and low-carbon sources being European as well as imports. However, in the draft scenario report, we note that:

- *in the GA scenario, the volumes of low carbon and renewable hydrogen imports are exactly the same : 247 TWh in 2040 and 468 TWh in 2050 (Figure 28). However, the starting point in 2030 isn't the same. It is surprising to see the exact same volumes for both renewable and low-carbon imported hydrogen in 2040 and 2050.*
- *According to the reports, hydrogen will be used in a wider range of sectors to better mitigate the challenge of deep electrification. Eurelectric disagree with a deeper and broader use of H2 beyond the hard to electrify sectors - i.e certain industrial sectors (e.g. steel, cement, chemicals) or selected heavy duty or long-distance transport segments. For the other sectors, we do not believe in the use of hydrogen due to its lack of energy and cost efficiency compared to direct electrification. In any case, the discussions on the future of hydrogen is inevitably linked to the kind of deployment of its market and the infrastructure allowing it. We would like to find more transparency on these two elements across the scenario descriptions.*
- *In DE scenario, hydrogen is mainly produced by electrolysis with electricity produced by European wind and solar capacity – complemented with a limited amount of SMR - andused in the hard to electrify sectors. We believe that this scenario is more credible and aligned with both the Commission's targets (H2 Strategy) and the industry application already engaged or foreseen.*

Looking at both scenarios from a broad perspective:

- *We note the total absence of unabated hydrogen produced from SMR (grey hydrogen), which is a very positive aspect (though with a feasibility to be proven in practice), fully aligned with the EC Hydrogen Strategy.*
- *The overall demand for hydrogen projected by the scenarios seems very ambitious. For instance, GA and DE scenarios see respectively 747 and 819 TWh, whereas Eurelectric's most ambitious decarbonization scenario sees 389 TWh. For Transport, it is respectively 780 and 563 TWh, but only 88 TWh in Eurelectric's decarbonization Study. For Residential and Tertiary, 451 TWh (GA) and 140 TWh (DE) are projected, against 72 for Eurelectric's Decarbonization Study.*

However, other sources of decarbonized gases such as synthetic e-methane seem to be considered as marginal both in GA and DE scenarios (lower than all scenarios of the EU Commission Impact Assessment). We believe that at least one scenario should consider the role of synthetic gases, which could help provide firmness to the electricity system via gas-fired assets."

Response:

We have adjusted the shares of low carbon and renewable hydrogen, taking into account Ukraine as an additional H2 supply source providing renewable H2 imports. We have increased the H2 production from dedicated renewables, in part dedicated offshore wind. We will look further into the dedicated offshore installations for the TYNDP 2024 scenarios. In our scenarios, we explore different possible

pathways of the future energy system. In Global Ambition, the usage of hydrogen in all sectors represents one pathway to reach the decarbonisation targets while Distributed Energy relies more on an increased use of electricity.

Feedback (EDF):

"As indicated previously, EDF notes that the two TYNDP's scenarios bet on a strong development of decarbonized gas, in particular hydrogen. Hydrogen is a key decarbonisation vector but it is essential to be careful about its development. More contrasted trajectories should be envisaged.
In the TYNDP's scenarios, hydrogen will be used in a wider range of sectors beyond the hard to electrify sectors - i.e certain industrial sectors (e.g. steel, cement, chemicals) or selected heavy duty or long-distance transport segments. Therefore, the overall demand for hydrogen projected by the scenarios seems very ambitious. For instance, GA and DE scenarios see respectively 747 and 819 TWh, whereas Eurelectric's most ambitious decarbonization scenario sees 389 TWh. For Transport, it is respectively 780 and 563 TWh, but only 88 TWh in Eurelectric's decarbonization Study. For Residential and Tertiary, 451 TWh (GA) and 140 TWh (DE) are projected, against 72 for Eurelectric's Decarbonization Study.
For France
Moreover, the assumptions for France are not consistent with RTE's recently published reference scenarios. Indeed, the two TYNDP's scenarios (198 TWh in DE in 2050 and 229 TWh in GA in 2050) are considerably higher than the highest RTE's scenarios (120 TWh of hydrogen in 2050). Not only are the trajectories not contrasted, but this also questions the sustainability of these trajectories. In the high variant of RTE, these difficulties are already pointed out at the level of transmission and storage infrastructures."

Response:

The TYNDP 2022 Scenario Report consists of one central policy scenario (National Trends) that recognises national and EU climate targets as reflected in the latest Member States National Energy and Climate Plans and two COP21 Scenarios (Global Ambition and Distributed Energy) that complies with EU Climate Law ambition. All together the two COP21 scenarios aim to create contrasted scenarios with differentiated narratives and assumptions that project long term demand and supply, explore uncertainties, provide insight on challenges that energy infrastructure is facing during the energy transition.

Feedback (Gas Distributors for Sustainability (GD4S)):

We regret that synthetic methane (methanation of H2 and CO2) has not been clearly assessed as a contributor to sector coupling. In synergy with biomethane production, its potential is significant and offers an efficient way to valorise hydrogen while using the existing gas infrastructure (storage) and appliances.

Response:

Based on your feedback, the domestic production of synthetic methane coupled with dedicated renewables was included in our scenarios.

Feedback (Eurogas):

"The contribution of other sources of decarbonized gases such as synthetic e-methane is considered as marginal both in the GA and in the DE scenario (lower than all scenarios of the EU Commission Impact Assessment). We believe that at least one scenario should consider the role of synthetic gases.
Neither scenario is taking the local production of hydrogen into consideration. We have the impression, that even this scenario is called "Distributed Energy" it only concentrates on electrification and rules out any distributed solutions for gas. We have voiced this concern several time in the past months and years but we don´t see that they have been taken into account.
Local H2 is only assumed from electricity which is a far to narrow assumption. As already mentioned in the workshops in 2020 the pyrolysis technology is considered as marginal which is considering the timeline until 2050 far to pessimistic. We think that in minimum in the distributed scenario more local production should be considered. This is also in line with the development on the waste sector, the stronger implementation of the waste hierarchy will automatically lead to either more hydrogen (from waste pyrolysis) or more biomethane. The technological development on the pyrolysis are fast, different feed stocks can be used including natural gas, biomethane, waste, waste-water. Hydrogen from methane pyrolysis following the to be defined foot-print threshold will be considered as low carbon, does not emit any CO2 and is scalable. It has the huge advantage that it helps to ramp up the local production of H2 and enable the full transition of local grids to hydrogen. It should not be forgotten that in many countries nearly 100 % of the industry and CHP is connected to the DSO level and not the TSO level. For the various industrial processes, it is either not possible – because of the process itself – or not efficient to use direct electrification. In addition, it is doubtable that the electricity distribution grid would be able to support this load. During the time of the Dunkelflaute all this electricity would have to come from conventional power plants running again on hydrogen which has to be included in the overall calculation of the efficiency. The local production enables the speed up of the decarbonization process and offers electrolysers and PV farm a outlet in times when the grid is overloaded. The first injection can start early on and use the ability of the gas grid and the consumers to operate on blends. As an example for the need of local hydrogen: the German TSO have called on the DSO in spring to deliver their demand of hydrogen for the year 2050 which came to 290 TWh. As this demand will increase slowly starting already in the next 5 years and due to the speed of the development of the hydrogen backbone in the regions local production is of the essence.
The distribution grids in Europe are already far more advanced for the transition to pure hydrogen. In Germany for example the pipes are nearly 100 % hydrogen ready. With the project Ready4H2 16 countries and 90 companies joined to present the status of the grids and deliver a roadmap into full decarbonization.
Imports: in the storyline report the countries were not defined. We think that Ukraine should be included in the countries – also regarding the last version of the EU Backbone – as it brings hydrogen to many more countries"

Response:

The TYNDP 2022 scenarios explore different pathways for infrastructure assessment. The TYNDP 2022 scenarios are designed to be fit for purpose for infrastructure assessment. Not only for electricity and methane, but also for hydrogen. Existing natural gas infrastructure can in the future be converted for hydrogen transport. Not only at the transmission level, but also for the local distribution grids. The latter would also enable the application of hydrogen in for example mobility or residential and tertiary heating. This is also reflected in the scenarios.

Furthermore, based on your feedback, we have increased the synthetic methane production from dedicated renewables. We will look further into the synthetic methane production for the TYNDP 2024 scenarios. Besides, we have adjusted the shares of low carbon and renewable hydrogen, taking into account Ukraine as an additional H2 supply source providing renewable H2 imports.

Feedback (currENT):

There is a massive dependency on hydrogen imports by 2050 in the GA scenario (1,000 TWh) yet there seems to be small assumptions on H2 production from dedicated offshore installations.

Response:

The TYNDP 2022 Scenario Report consists of one central policy scenario (National Trends) that recognises national and EU climate targets as reflected in the latest Member States National Energy and Climate Plans and two COP21 Scenarios (Global Ambition and Distributed Energy) that complies with EU Climate Law ambition. All together the two COP21 scenarios aim to create contrasted scenarios with differentiated narratives and assumptions that project long term demand and supply, explore uncertainties, provide insight on challenges that energy infrastructure is facing during the energy transition.

Feedback (ENGIE):

"We believe that Green hydrogen will be the massively used in 2050 (+/- 1.500 TWh). However, we believe that the amount of green hydrogen estimated in both scenarios for 2040 (+/- 1.000 TWh in DE and +/- 800 TWh in GA, based on fig. 28 in the Report) is too ambitious. Also figures for 2030 for green hydrogen (up to +/- 270 TWh) appear above the already ambitious RFNBOs subtargets for industry and transport embedded in the Fit-for-55 package.
We also believe that – as explained in the more general statements – the two scenarios should be more differentiated among themselves in order to capture technologic uncertainty.
Moreover, as stated in Q26, we rather agree with the EU Commission's Impact Assessment scenarios where hydrogen will be mainly produced in Europe and transported throughout the continent. Having said that, the expected volumes of H2 for the EU market are very ambitious, so the option of hydrogen imports from outside EU must be regarded. That's clearly a feasible solution (e.g. via pipelines from North Africa). Of course, the soundness of the assumption (up to 1.000 TWh of imported hydrogen in Global Ambition in 2050, but without information on the geographical sources) should be checked given especially the transportation costs over very long distances.
Furthermore, the contribution of other sources of decarbonized gases such as synthetic e-methane however is considered as marginal both in the GA and in the DE scenario (lower than all scenarios of the EU Commission Impact Assessment). We believe that both scenarios should reflect a more important role to synthetic gases in the towards a fully decarbonized energy supply.
Finally, data from the Visualization tool and from the Report (figure 28) appear not to be coherent."

Response:

In our scenarios, we explore different possible pathways of the future energy system. In Global Ambition, the usage of hydrogen in all sectors represents one pathway to reach the decarbonisation targets while Distributed Energy relies more on an increased use of electricity.

Based on your feedback, we have increased the synthetic methane production from dedicated renewables.

Feedback (Edison S.p.A.):

"The hydrogen part in the final demand is particularly high. For example, in Italy it is estimated in a range between 194 TWh and GA 244 TWh in the TYNDP scenario report. It seems to be very ambitious, since national sources provide figures closer to 170 TWh (cf. "Strategia Italiana di Lungo Termine sulla riduzione delle emissioni dei gas a effetto serra" published on sept 30th 2021, Paragraph 2.2.2).
We would expect to be given more details on how the H2 is produced, since the RES production could have reached its limit. Indeed, the alternative would be to rely hugely on hydrogen import that could be an hazardous hypothesis.

Moreover, on the other hand, the development of hydrogen production has to be consistent with the development of hydrogen final uses and hydrogen storage capacity. This would also require more details on how the hydrogen will be transported, stocked and used by final customers."

Response:

More details of the H2 production have been included in the updated scenario report.

Feedback (BDEW Association of German Energy and Water Industries):

"BDEW agrees that while there can be no doubt about the overall future role of hydrogen in a new integrated energy system it is extremely difficult to quantify concrete demand.
BDEW supports the approach of the GA scenario in which hydrogen comes from a wider range of renewable and low-carbon sources being European as well as imports. As a result, it will be used in a wider range of sectors better mitigating the challenge of deep electrification."

Response:

Thank you for your comment.