TYNDP 2024 Scenarios Storyline Report

A Eurelectric response paper

August 2023

Eurelectric represents the interests of the electricity industry in Europe. Our work covers all major issues affecting our sector. Our members represent the electricity industry in over 30 European countries.

We cover the entire industry from electricity generation and markets to distribution networks and customer issues. We also have affiliates active on several other continents and business associates from a wide variety of sectors with a direct interest in the electricity industry.

We stand for

The vision of the European power sector is to enable and sustain:

- A vibrant competitive European economy, reliably powered by clean, carbon-neutral energy
- A smart, energy efficient and truly sustainable society for all citizens of Europe

We are committed to lead a cost-effective energy transition by:

investing in clean power generation and transition-enabling solutions, to reduce emissions and actively pursue efforts to become carbon-neutral well before mid-century, taking into account different starting points and commercial availability of key transition technologies;

transforming the energy system to make it more responsive, resilient and efficient. This includes increased use of renewable energy, digitalisation, demand side response and reinforcement of grids so they can function as platforms and enablers for customers, cities and communities;

accelerating the energy transition in other economic sectors by offering competitive electricity as a transformation tool for transport, heating and industry;

embedding sustainability in all parts of our value chain and take measures to support the transformation of existing assets towards a zero carbon society;

innovating to discover the cutting-edge business models and develop the breakthrough technologies that are indispensable to allow our industry to lead this transition.

Dépôt légal: D/2023/12.105/32

Customers & Retail Services
Markets & Investments Committee
Generation & Environment Committee
Electrification & Sustainability Committee
Distribution & Market Facilitation Committee
WG Regulation & Network Customers
WG E Mobility
WG Electrification & Energy Efficiency
WG RES & Storage
WG Thermal & Nuclear
WG Power & Gas Interactions
WG Hydro
WG Wholesale Market Design & Investment Frameworks
WG Market Integration & Network Codes

Contact:
Abi Afthab OLIKATHODI, Analyst - Energy data & scenarios –
aolikathodi@eurelectric.org

Scenario Strategy & Storylines

ENTSO-E and ENTSOG published the TYNDP 2024 Scenarios Storyline Report, that includes the scenarios frameworks, the storyline matrix and gap closing methodology for the NT+ energy mix. As the storylines are built upon 2022 Storylines, includes the stakeholder feedbacks from last cycle's extensive consultation and also from the Storyline Update Webinar from July 2022, they are now considered final. Any feedback will be considered for the 2026 cycle except for the Annex-2 NT+ Energy Mix Gap Filling Methodology which is part of this public consultation.

4. Please provide your comments about the TYNDP 2024 scenarios strategy.
Specify

An element missing is EU's reliance on critical raw materials for clean energy technologies. It is true that one of the elements defining the scenario strategy is EU's level of independence in terms of energy supply, industrial activity, agricultural yield and consumer goods. However, we should bear in mind that EU depends excessively on third countries (especially China) for the critical raw materials required for the clean technologies like Solar PV, Wind and battery technologies. For example, EU has less than 10 % share in global production of lithium-ion batteries at different stages of its supply chain including raw materials, processing, components and assemblies. TYNDP should be able to assess the vulnerability of the EU in terms of this excessive dependence.

Furthermore, the decarbonization of certain countries relies on the development of renewable energies in other countries, in Europe or outside Europe, which is far from certain. Moreover, the NECPs do not systematically integrate the development of power capacities to export. The flows (power, gas or hydrogen) between European countries should be more transparent and the impact of these flows on the energy mix for each country should be explained.

5. Do you agree on one central scenario in 2030 aligned with ACER's Framework Guideline?

- Yes
- No

If you selected No, please specify

First of all, it is not clear that central scenario (NT+) will be in line with EU's latest climate ambitions including the upgraded 42.5 % RES target and other provisional agreements set this spring between the EU Council and Parliament in the scope of the new RED III Directive. While the timeline required for delivering the proposed scenarios may explain some delays in incorporating the latest climate ambitions in such a NT+ scenario, we notice that ENTSOs use it for system needs identification study and the Cost Benefit Analysis for the PCIs. Therefore,, we urge ENTSOs to also use the DE and GA scenarios for the CBA. Should the NT+ scenario exclusively be used for the CBA, we consider that it would be detrimental for the proper identification of infrastructure needs to meet EU's climate targets and risk nonefficient assessment of infrastructure in the long term scenarios, with clear impact for the decisions to be taken in the short term.

We also acknowledge that NECPs (on which the NT+ scenario is relying on) have not been released by national governments and currently national TSOs' best estimates are used for the NT+ scenario. On another aspect, we notice that some technology trajectories we saw that these are not in line with the technology ambitions announced by national goverments (eg: Solar PV ambitions by Italy and Spain). Therefore, we fear that NT+ scenario will finally not be in line with latest policy ambitions of the national
, which can be detrimental to the accuracy of the assessment of infrastructure needs stemming from various technologies growth.

Therefore, NT+ scenario should be conveniently updated once the NECPs are published. We would also like to remind about the option to ask the Commission or ACER to activate the so called ‘quick update process’ to conclude updates within 8-10 weeks.

Additionally, from a formal point of view, the amount of data provided with large room for improvement in terms of clarity with the given deadline for scrutiny by stakeholders is visibly aside of the asks of ACER referred to clarity and opportunity to provide timely and useful feedback.

6. What are your views about the updates for the 2024 Scenarios Storylines Report?
Specify

The section ‘What is new in the TYNDP 2024 storyline report’ could be clearer to inform the readers about the exact updates in the 2024 scenario storyline report compared to the 2022 version. The same section in the previous year version had clearly written about the updates. To answer this question, we had to look at the 2022 storyline report and compare with the current version. On the positive side, the initial narrative describing the different scenarios, that convey relevant differences in terms of relative share of the energy drivers and infrastructure, is drafted in a more neutral language.

Eurelectric finds the two annexes added (storyline matrix and the NT+ gap filling methodology) very useful. However, our general feeling is that the current version is inferior to the previous version in terms of content. The 2022 version included a chapter on quantification of key parameter which was really useful for readers to get a broad overview of the quantification of the high level parameters like overall electrification rate and energy intensity, without the need to consult several spreadsheets and the “demand visualization platform” with some data inconsistencies. In fact, this chapter was skipped this year because the quantification details are available through dedicated excel sheets and visualisation. We still think that such a written chapter will still be useful for the future versions for readersand ease the analysis through all the excel sheets associated with the report.. We also identified contradictory numbers for electrification rate when we assessed the visualisation and the excel sheet. Still, it is not clear for us what is the electrification rate foreseen in the TYNDP 2024 scenarios.

We would also like to highlight the recent developments related to Net Zero Indusrty Act (NZIA) that might affect the storyline assumptions of the GA scenario. The storyline scenario Global Ambition reflects 'Global economy with centralised low carbon and RES options', its driving force of the transition has assumed 'Higher' benefits from global synergies through global trade (page22-23 of the report). This assumption may not be realistic at least in mid-term towards 2030 or even longer, considering the upcoming new reality resulting from the Net Zero Industry Act (NZIA), which set outs an indicative 2030 EU manufacturing target for strategic Net Zero technologies of at least 40% of EU annual deployment needs, and 65% threshold to diversify sources of supply of net-zero technologies away from single sources. These NZIA measures mean less global trade synergies and higher supply chain costs at least in mid-term.

7. What would be the other important drivers (please see the 2024 Scenarios Storylines Report, Figure 3) that you would like to see in the next cycle? (Please provide an explanation on how it could be included and differentiated among scenarios)
Specify

Electrification is an important feature of all three scenarios but there could be room for being even more ambitious in the electrification of energy end-use. The share of electricity in final demand reaches 58% in DE and 42% in GA but could be pushed significantly higher. Direct electrification is always more energy efficient than indirect through power-to-X. It could also be considered to establish a new scenario that focus on electrification as the main measure for decarbonizing limiting the use of other energy carriers and fuels to only the most hard-to-abate applications.

We would like to specify an additional element to consider under the important driver 'energy efficiency'. When considering energy efficiency as a driver, for conceptual reasons and for the practical implementation of MSs' targets,, it's important to consider the efficiency vis-à-vis primary energy demand and not just the efficiency on final energy demand. Primary energy demand considers the energy that is used directly from natural resources such as coal, oil, solar, wind, etc, whereas final energy demand measures the energy that is consumed by end users and do not account for the losses over the value chain during energy conversion, transportation, and distribution. It accounts for the efficiency at which these raw sources are converted into usable forms of energy. By incorporating primary energy efficiency all losses associated with conversions can be properly accounted. This approach can often reveal inefficiencies or opportunities for improvements i that might be missed if only looking at final energy demand. The difference in primary energy consumption and primary energy supply for the scenarios should be clearly communicated.

Moreover, we should keep in mind that the two long-term scenarios are diverse and show a broad range of pathways in the sense they choose two different routes (centralized or distributed) towards Paris compliance. The risk is that if these scenarios are used for planning purposes, planning based on one for them excludes elements from the other one. In reality, a pathway aiming to achieve the 2050 targets will need to resort to a combination of solutions from both scenarios.

8. What are your views about the gap closing methodology for NT+ scenario? (Please see the TYNDP 2024 Scenarios Storyline Report, Annex 2)
Specify

If there is a gap in energy demand reduction |(just an example) from NECPs, then ENTSOs fill this gap using the gap closing methodology. Here ENTSOs use the share of different sectors and sub sectors/carriers to this energy demand and the energy demand will be reduced pro-rata. Also, same approach will be used to split the reduction among countries. However, it is not clear to us what would be the approach if a few countries are already very ambitious with their NECPs and their demand reduction is already above the EU targets. In such cases, pro-rata approach may be questionable. Same applies to the countries who might be far below the EU targets. These countries should be identified, and the pro-rate approach should be adjusted to reflect these specificities. Furthermore, it is unclear if the gap closing methodology does also apply in a situation where the bottom-up approach by TSOs does not meet other targets, eg. the renewable targets.

Demand Figures for DE & GA Scenarios

The TYNDP 2024 Demand Scenarios are now quantified with Quintel's Energy Transition Model (ETM) tool, which is open source and available for the general public. The spreadsheet 20230704 – Draft Demand Scenarios TYNDP 2024 provides all the country links where interested stakeholder can transparently see all relevant input and output parameters. Please note that a dedicated version of the ETM (https://tyndp2024.energytransitionmodel.com/) is created for the TYNDP 2024 scenarios to ensure stability and transparency throughout the whole scenario development process.
Please note that only the demand-side of the ETM has been configured. All other values have been left at their default values and do not represent the vision of the authors. For the analysis of the final energy demand per sector, per carrier and market shares of technologies please visit the Visualisation Platform available on our website.

9. What are your views about the added value of this transition to the new tool (ETM) for the transparency of the scenarios building process? (1 - no added value ; 10 very high added value)

7
The tool would be useful for someone who has enough time to elaborate scenario. Unfortunately, at this point of time, due to tight timeline we could not utilise the tool. However, we appreciate this effort by ENTSOs because we could use this tool in the future for any scenario building exercise. We would also appreciate if there could be EU aggregated numbers in the tool as it is not the case now. Also, there were some technical issues in accessing the tool which was communicated to ENTSOs by email. Also, we would appreciate if the results are provided in English (not only in Dutch)

The term "blackouts" used in the model should be avoided. Indeed, the ETM does not model the number of hours of "blackout" but the number of hours Energy non distributed (which leads to calls emergency actions – interruptibility, reduction of tension – or load shedding). A blackout occurs when the gap between supply and demand is immediate and leads to an electricity system collapse.

10. Do you think the demand figures within DE & GA scenarios are consistent with their storylines?
- Yes
- No

If you selected No, please explain

It seems that there is a discrepancy between electrification rate in the visualisation platform and the draft_supply_tool (cf. Sheet: Results and figures). For instance, the electrification sharein 2050 in the DE scenario's final energy demand(only energetic) is 58 % according to the visualisation platform whereas it is 49 % in the draft supply tool which is very low considering the role electricity will play in decarbonisation of the EU.

On demand figures, we notice that the two scenarios are built with contrasting electrification share and hydrogen share.. The electricity share in final energy demand is very low in GA compared to the DE scenario whereas hydrogen share in the final energy demand is very high in GA compared to the DE scenario. According to the storyline, GA scenario is a technology driven scenario with low carbon and RES options. This doesn't mean that we need to undermine the role of electrification in the GA scenario. This is especially visible in the electrification of transport, as seen below. Also, in both scenarios, it seems according to explanations during 13th July workshop that the electrification of heavy road transport is not considered and the electrification is getting saturated after 2040 and there is very slow uptake of electrification after that.

While setting diverse alternative scenarios on evolution of supply and demand per energy carrier is understandable as fully part of the TYNDP exercise (the latter intending to test the resilience of the infrastructure in various possible futures), we surprisingly notice a decline in electricity demand in the residential sector post 2040. In the decarbonization scenarios of Eurelectric released in June 2023, the growth in electricity demand slows down from 2040 to 2050 due to the increased efficiency of electrical technologies. However, these scenarios do not indicate a decrease in electricity demand.

Electrification has a greater role to play in the decarbonisation of residential sector and other buildings. As a reminder, Eurelectric foresees a 70 % electrification in residential sector by 2050 whereas DE and GA has only 54 % and 47% electrification in residential sector. Another strange observation is about the share of electricity and hydrogen in the transport sector in 2050. The greater role of EVs in transport compared to FCEVs are globally well acknowledged. However, in the GA scenario, we see an almost equal share (31%) for electricity and hydrogen in the final energy demand which is questionable to us. As an example, Eurelectric believes that the market share of electricity in transport should be 53 %.

11. Do you think the market shares of technologies within DE & GA scenarios are consistent with their storylines?

- Yes
- No

If you selected No, please explain

Please see the answer for Q10.

12. Do you think the amount of biomass in the scenarios is sustainable?

- Yes
- No

If you selected No, please explain

The biomethane potentials for France included are excessive and not credible. The biomethane French production would reach respectively in DE and GA 270 TWh and 202 TWh in 2050. However, the recent study by France Strategy provides detailed assessments of the potential resources that can be mobilized to produce energy. It develops two contrasted scenarios of agricultural development which lead to estimates of mobilizable primary resources of between 76 and 89 TWh, which represents a potential for the production of biomethane from agricultural resources of between 60 and 70 TWh. The study relies on reasonable mobilization rates, and also considers competition in use with direct heat recovery for certain resources. Adding the waste potential (household waste, residues from agri-food industries, etc.) to thisagricultural resource should be added the waste potential represents a volume of raw resources of around 15 TWh. This mobilization potential highlighted by the France Strategy study probably represents an upper limit because the massive production of biomethane from CIVE is an uncertain path. Therefore, at least one scenario should have a prudent approach and adopts a potential for the production of biomethane from agricultural resources and waste of between 70 and 85 TWh by 2050. In any event, the potentials currently assumed are excessive and not credible.

Supply Figures for DE & GA Scenarios

The draft supply figures and their methodologies can be reached via 20230704 – Draft Supply Inputs for TYNDP 2024 Scenarios for consultation and 20230704 – Draft Supply Tool (EU-level). The first spreadsheet includes the country specific renewable and battery trajectories, nuclear capacities, the cost of the technologies, the commodity and CO2 prices and extra EU import potentials. Please note that the Best Estimate figures within the trajectories are not part of the consultation as they represents TSOs' best estimate for the upcoming NECPs whose draft version should be submitted to the EC in summer of 2023. The Draft Supply Tool excel quantifies the supply details for the total energy demand of each energy carrier.
ENTSO-E and ENTSOG also published their electricity and hydrogen reference grid for information within 20230704 – Electricity and Hydrogen reference grid and investment candidates. Please note that this document also includes the project candidates for electricity whose CAPEX are according to ENTSO-E's proposal, and project candidates for hydrogen whose CAPEX are calculated according to ENTSOG's proposal. These draft cost methodologies and figures are part of this public consultation.

13. In your view, are the RES trajectories (wind, solar, battery) & nuclear capacities reasonable?

Like in our answer to question 5, we have noticed some discrepancies for the trajectory of solar PV with the recent announcements from national governments. In the case of Italy, for instance, the government has established in the recent update of the NECP a target of c.a. 80 GW for which would then suggest, to our opinion, a possible target of around 150 GW of solar PV by 2050.. However, the TYNDP 2024 scenario foresees only 74 GW as the best estimate for 2030 with even the high estimate falling below the national ambition. For 2050, the best estimate only reaches 113 GW which is not aligned with the recent government announcement. Similar flaw can be observed for Spain where the national government has established in its recent update of the NECP a target of 76 GW for 2030 from which we expect around 120 GW of solar PV by 2050. However, TYNDP only take 53 GW as the best estimate for 2030 and reaches only 107 GW in 2050. Softening high estimates, even below certain country statements may be justified, given the ambitions of many NECP, but needs to be explicitly addressed. Furthermore, it is unclear how the solar rooftop share (rooftop vs. total) has been calculated, with significant differences across the countries. For example, the hypothesis for Spain (2030: 76.6%, 2040: 64.7%, 2050: 59%) seem too high (e.g., Germany is below 50%). These hypotheses may lead to very different assumptions on batteries. Precisely, regarding prosumer battery trajectories it seems surprising that most countries show “zero” value in base and low scenarios.

Upper and lower ranges for RES trajectories should be more differentiated. For instance, solar trajectory in Germany can go from 434GW to 507GW in 2050, only 17% difference: this doesn’t enable the TYNDP to capture the broadest possible future. Furthermore, 434GW as a lower range when the government aims to have 400GW of capacities in 2050 sounds too optimistic. Another example is the absence of difference between Belgium’s RES trajectories ranges. In general, we recommend more contrasted but realistic scenarios.

For nuclear, we would also like to remind about the recent joint Declaration announced by Nuclear alliance (16 EU countries are part of it), where they acknowledge that nuclear power may provide up to 150 GW of electricity capacity by 2050. The DE and GA scenarios foresee 51 and 134 GW respectively. We think the 51 GW assumed for DE is very low in the context of this announcement by the Nuclear Alliance.

Also, for the particular case of Slovakia, there are gaps on nuclear capacity when looking at national government communication.

DE			NT+		
2030	2040	2050	2030	2040	2050
2351	2351	1418	2815	2830	3096

As shown above, the nuclear installed capacity proposed in 2050 DE scenario is half lower than the 2050 National Trends+. This implies phasing out 3 units out of total 6 in Slovakia (phase out of 2 units in Jaslovske Bohunice, and possibly not commissioning of Mochovce Unit 4 which is currently under construction with expected completion in 2025). However, during the latest data collection for updating the Slovak NECP, it has been communicated that the ambition is to operate Jaslovske Bohunice Unit 3 and 4 for at least 70 years. Therefore, nuclear installed capacity should be in 2050 DE scenario approximately 2800+ MW (see below).

DE			NT+		
2030	2040	2050	2030	2040	2050
2815	2830	2830	2815	2830	3096

Even in the low estimated scenario (The Jaslovske Bohunice Unit 3 and 4 would be phased out in 2045), the data for 2050 DE should still be higher than 1418 MW (see below)

DE			NT+		
2030	2040	2050	2030	2040	2050
2815	2830	2064	2815	2830	3096

14. In your view, are the technology costs appropriate?
technology costs

We observe that the Solar PV technology cost is increasing from 2040 to 2050 for both rooftop and utility scale which is unrealistic considering the huge of uptake of solar PV in the future and the economies of scale that would be achieved. From the TYNDP roundtable held in July 2023, it is understood that this is mistake due to a formula error, which hence would now need to be corrected.

Regarding the capex of hydrogen turbines, we take note of the assumptions made on the 10% additional capex for hydrogen turbines compared to the gas CCGTs, the latter being a a mature technology. Looking at some recent cost for hydrogen turbines (1320 USD/kW), the current capex assumed for 2030 is 23 % lower than the current level. ENTSOs considered only 2 % reduction in the capex of hydrogen turbines between 2030 and 2040 and then until 2050. Assuming 23 % reduction capex in the next 7 years is questionable.

We also notice that the sources for technology costs are not provided. It would be appreciated if the sources used were provided.

15. In your view, are the prices (presented in the 20230704 – Draft Supply Inputs for TYNDP 2024 Scenarios.xlsx, sheet 3) appropriate?

We see a trend of decreasing price for crude oil and coal. However, Eurelectric thinks that the prices will increase in the coming decades that is also aligned with the European Commission. Please see Implementing the RePower EU Action Plan: Investment needs, hydrogen accelerator and achieving the bio-methane targets Annexe 7.Eurelectric decarbonisation scenarios sees the following projection for natural gas, coal and oil.

Fuel Type	Year	Fuel Price [€/GJ]
Coal	2030	3.00
	2040	3.46
	2050	3.81
Oil	2030	13.67
	2040	16.62
	2050	20.11

CO2 prices for advanced economies issued by IEA APS 2022 scenario (https://iea.blob.core.windows.net/assets/830fe099-5530-48f2-a7c1-11f35d510983/WorldEnergyOutlook2022.pdf page 465,) are respectively for years 2030, 2040 and 2050: 135 USD21, 175 USD21 and 200 USD21. In the TYNDP, those numbers were converted to euros with the rate 1 EUR21, = 0,84 USD21 (113 EUR21, 147 EUR21, 168 EUR21). However, knowing the high inflation rate of 2022, we believe this should be converted in EUR22. With an average inflation of around 8,4% in the euro zone, those numbers become: 123 EUR22, 160 EUR22 and 183 EUR22. The same actualization is valid for all data coming from IEA APS 2022.

16. In your view, are the extra-EU methane import potentials reasonable?

- Yes
- No

If not, please provide us an alternative source (should be reliable and cover 2050 time-horizon)

No views

17. In your view, are the extra-EU H2 import potentials & prices reasonable?

- Yes
- No

If not, please provide us an alternative source (should be reliable and cover 2050 time-horizon)

Prices based on the presentation of the European Hydrogen Backbone seem too low compared to current existing projects and even expected developments, following other assumptions (between 25-40% below in the horizon 2030). On the contrary, volume assumptions seem too aggressive.

Coming to interconnections, 9GW ES-FR at 2030 seem too aggressive unless linked to clear justification on the demand and supply flows for the countries involved. The hypothesis on CAPEX related with the interconnection ES-IT up to 13.33 GW need additional clarification.

Furthermore, An important part of hydrogen seems to be imported from outside of Europe, in particular from Norway and North Africa. To reach carbon neutrality, it is essential that these imports be decarbonized, it means produced from renewable or low carbon power technologies or natural gas with SMR+CCS. For North Africa, the needs of electricity to produce hydrogen could be higher than the current production, it means a huge investment in renewable energy (in addition of indispensable investments to decarbonize their own power demand). To produce 348 TWh of hydrogen from renewable energy, between 200 and 350 GW of renewable energy is needed. Such amounts of investment question the credibility of the scenarios.

18. Do you agree with the methodology on how the demand is supplied per energy carrier and how the conversion factors are used? (See 20230704 - Draft Supply Tool (EU-level).xlsx)

- Yes
- No

If you selected No, please specify

We are not sure to understand the context of the question. If you are referring to the 'Other data and Conversions' of the 20230704 – Draft Supply Tool (EU-level). Xlsx, we are not convinced about the distribution of heat into different energy carriers in the NT+ scenario. If this is showing the share of different energy carriers to meet the heat demand, the electrification share in the heat demand appears to be very low in 2030. On an average, the average electricity share in heating is 15 % according to the data. We feel this is very low compared to what is needed to achieve the 55 % GHG reduction target and 42.5 % RES.

Also, it is not clear why the efficiency of all energy carriers is given as 100 % for some countries. This is not explained anywhere in the datasheet.

19. Do you think the preliminary supply figures are differentiated according to the storylines?

- Yes
- No

If you selected No, please specify

Please refer to answer to Q10. Additionally, the EU production of hydrogen by electrolyser by 2040 are around 900 TWh and 1400 TWh respectively. We think that this is very ambitious considering the current electrolyser capacity what we have in Europe (<1 GW). For 2040, this is around 23 million tonnes of hydrogen production in the EU by electrolysers and would require around 330 GW electrolyser capacity by 2040 considering an efficiency of 70 % and capacity factor of 45 %. This is approximately adding around 20 GW electrolyer capacity every year from now onwards which looks very ambitious.

20. What are your views on the cost methodology of H2 investment projects? I.e., 75% repurposing and 25% new build, European Hydrogen Backbone report as cost basis, 15% distance between capitals?

The methodology proposed of H2 investment projects seems slightly incorrect in the first place, as the last version of the European Hydrogen Backbone, published in July 2023 (European Hydrogen Backbone, *EHB initiative to provide insights on infrastructure development by 2030*, 10 July 2023), anticipates a ratio of 60% of repurposed pipelines and 40% new build in the EU by 2040 (57,662 km of pipelines, and among them 34,290 km of repurposed gas pipelines). Moreover, literature shows a range of 50-80 % repurposing potential for natural gas pipelines of which 75 % is in the upper

range. We request that TYNDP process should assess it a non-biased way with proper identification of sensitivities in case if the numbers inputted doesn't materialize. Also, we request caution while inputting the cost for these pipelines. Being a nascent market, the dearth of available and fact-based information on hydrogen pipelines deployment costs in the literature makes the H2 costs assumptions setting a quite challenging exercise.. Therefore, we request caution regarding costs assessment for any H2 infrastructure project.
It also remains unclear what is the role of repurposing vs. new investment in the configuration of the reference H2 grid and investment candidates.

Hydrogen infrastructure projects face different technical challenges and various costs, as well as different timeframe of deployment, depending on whether they are newly deployed or repurposed from existing gas infrastructures. The technical viability of transporting hydrogen by repurposing existing gas pipeline should be demonstrated, with adaptations of all or parts of the gas network required to ensure the integrity of converting the network to hydrogen depending on the composition of the materials (risks of hydrogen embrittlement of steel, risks of leakage for polyethylene distribution pipes). Such repurposing also requires the replacement of auxiliary equipment and the adaptation of compression capacities (replacement and increase in the number of compressors, every 600 km).

In addition, depending on levels and trajectories of gas consumption in each country, existing gas infrastructures might not be available to be repurposed to hydrogen for the period covered by the TYNDP. It is the case for instance in France, where according to French NRA only 3 to 5% of current gas transmission pipelines could be available and free to be repurposed to hydrogen by 2050 and almost no portions available by 2030[1]. Therefore, most of infrastructures projects in France would need to be new built.

Furthermore, hydrogen quality issues can arise during transit in repurposed gas pipelines, when hydrogen is reacting with small amounts of residual methane, thus compromising its purity. However, certain uses of hydrogen for the industry or for mobility, in interaction with a fuel cell, require very high purity rates of hydrogen according to 3.5 or 5.0 standards (more than 99.97% by volume). Maintaining a high purity standard of hydrogen with the integration of hydrogen purification units at the entrance and/or exit of hydrogen networks would generate additional costs.

There are therefore significant uncertainties about the capital and operational costs of transporting hydrogen from repurposed or new built infrastructures. Regarding new hydrogen infrastructures, they require additional investment expenditures, up to 60% of additional CAPEX costs compared to repurposed infrastructures.

Finally, the figures put forward by the European Hydrogen Backbone initiative are based on underlying optimistic assumptions with high utilization rates and extensive reuse of existing infrastructure. Depending on infrastructure sizing, the range to assess hydrogen pipeline transport costs varies in the literature: €0.11 to €0.21/kgH2/600 km (EHB 2022), €0.38 to €1.13/kgH2/600 km (IEA 2021)[2], or €0.54 to €1.66/kgH2/600 km (Agora Energiewende 2021)[3].

Also, we think that it is important to input the reference grids both electricity and hydrogen grids to assess the electricity and hydrogen investment candidates since we will have an integrated

[1] Energy Regulatory Commission (CRE), *Study on the future of gas infrastructures*, April 2023
[2] International Enery Agency, Global Hydrogen Review 2021, octobre 2021
[3] Agora Energiewende, No-regret hydrogen. Charting early steps for H2 infrastructure in Europe, Janvier 2021

energy system with cross-sector synergies. It is not clear what data TSOs submitted for the hydrogen reference grid for 2030, is it based on existing hydrogen grid or existing gas network or the hydrogen pipeline that are expected by 2030? We fear that these many hydrogen grid capacity might not materialise by 2030 even if the assumption is that most of these will be repurposed gas pipeline or all hydrogen pipeline will be built by 2030. Ultimately this might result in underestimation of hydrogen infrastructure, overestimation of hydrogen demand and lower electrification. We understand that for modelling purpose we would need some numbers on hydrogen reference grid as a starting point. However, we should make sure that we put realistic numbers. For transparency, we request ENTSOs to clearly publish the basis for hydrogen reference grid to assess whether the numbers are realistic or not.

21. What are your views on the cost methodology to for electricity investment candidates? I.e., to use submitted candidate projects as electricity investment candidates?
Specify

No views.

Modelling Methodology and Assumptions

The innovations implemented in the TYNDP 2024 Scenarios seek to improve those already implemented in TYNDP 2022. The aim is to enhance the representation of a fast-changing energy system and the integration of its different sectors. The TYNDP 2024 scenarios presents five main innovations which are EV Modelling, Hydrogen (P2G) Modelling, Offshore Modelling, Hybrid Heat Pump Modelling and Expansion Modelling. For the details, please check 20230704 – Modelling Methodologies & Draft Assumptions, 20230711-H2 Steel Tank Methodology and 20230711 - Carbon Budget Methodology documents under the download section.

22. In your view, is the carbon budget methodology appropriate?

- Yes
- No

If you selected No, please provide an alternative source

No views

23. What do you think about the EV innovation & its relevance to the scenario model? (rank 1 to 10 - 10 most satisfactory)

Rank from 1 to 10

7

24. In your view, are the assumptions on the EV methodology reasonable?

- Yes
- No

If not, please provide us an alternative source (should be reliable and cover 2050 time-horizon)

The efficiency assumed is not reasonable and is very high. The general range is somewhere around 150-170 wh/km but TYNDP has assumed 200 wh/km for all the years which is very high. Please look at EC's impact assessment fleet methodology sensitivity assumes 170 wh/km. The Bloomberg Energy Finance EV outlook 2021 assumes 140-170 wh/km already for 2025 and 2030. This can only go down by 2050 and not go up. In addition, the treatment of the heavy road transport in the different scenarios remains unclear (apparently excluded) as well as the electrification of ports.

Additionally, we have some questions on some of the assumptions that are not clear to us. Slide 18 of the methodology slide deck says that "charging stations at home and by the streets is an average of what is currently on the market. The methodology of these charging stations is limited to 22 kW. Higher capacity charging stations are handled separately in the modelling". We understand the logic behind restricting it to 22kW for private chargers, as most private EV charging stations can deliver from 11 to 22 kW. Then we are doubtful about the usage of average here. By average, do you mean you will consider the average only on the distribution of home charging stations and street charging stations. Or are you also going to estimate the capacity of charging stations in this way. It is not clear what would be the capacity that will be used for street charging stations. We should mindful of the most powerful chargers out there in the market. We are not sure how this will be dealt with in the modelling.

25. How could the methodology be improved for the next cycle?

Please explain

We urge ENTSOs to base the assumptions for EVs considering more literature. Currently all the numbers used according to our understanding are from the ETM. We would request these numbers to be double checked before using.

Also, our understanding is that currently only passenger cars are only included in this methodology and for heavy vehicles a simplified approach has been used. If this is the case, next cycle should target including heavy duty vehicles in this approach. The electrification of ports and the incorporation of decarbonised fuels to vessel and airplanes should also be made explicit.

26. What do you think about the P2G innovation & its relevance to the scenario model? (rank 1 to 10 - 10 most satisfactory)
if not please provide us an alternative source (should be reliable and cover 2050 time-horizon)

8

27. In your view, are the assumptions on the P2G methodology reasonable?

- Yes
- No

if not please provide us an alternative source (should be reliable and cover 2050 time-horizon)
28. How could the P2G methodology be improved for the next cycle?

Please explain

We appreciate that the P2G methodology has improved a lot from the previous year. Nevertheless, we consider that there are still room for improvement. One element missing is the several ways of transporting hydrogen. It is known that hydrogen can be transported by either pipeline in gaseous form (this is what in the model) and another transportation means such as high-pressure tube-trailers. In other words, rolling out of the hydrogen market could be envisaged via a both centralised and decentralised way of transporting hydrogen, to a certain extent. We fully understand that the TYNDP exercise focuses on pipelines transport development, being a network development exercise, but we suggest ENTSOs to give more details on how the other transportation means are considered here. This will also give a better picture on the infrastructure requirement.

The current methodology can also be improved in terms of incorporating different ways of storing hydrogen. Currently only three storage technologies are used in the model: pipeline, steel tanker storage and underground storage. We assume that only salt caverns are considered as underground storage. Giving some cost assumptions on thse storage would also be welcome.
It would also be logical to consider the dynamic characteristics and associated operational restrictions of the electrolysers in the model. For example, the efficiency of electrolyser vary when they are in partial and full load. Alkaline electrolysers are not usually operated below 40 % partial load due to safety reasons. Currently, the methodology doesn't take these restrictions into consideration. This could also vary according to the technology of electrolyer (alkaline and PEM). PEM electrolysers have better efficiency in partial load.

Furthermore, electrolysers have the capacity to regulate or upward that enables them to provide ancillary services to the grid, , but given the circumstances above, could also represent new constraints.. It would be interesting to assess this potential of electrolysers. Please note that this is missing in the TYNDP for other power producing technologies as well. We also request ENTSOs to publish the technical parameters used for these technologies.

29. What do you think about the offshore innovation & their relevance to the scenarios model? (rank 1 to 10 - 10 most satisfactory)

8

30. In your view, are the assumptions on the offshore methodology reasonable?

- Yes
- No

if not please provide us an alternative source (should be reliable and cover 2050 time-horizon)

31. How could the methodology for offshore be improved for the next cycle?
Please explain

We do not know how the model would differentiate between the current discussion of an OBZ set up or a home market bidding zone set up for offshore hybrid projects. Is the current methodology assuming that all offshore hybrids would go into offshore bidding zone? It is highly likely that some countries would go for a home market bidding zone and some countries would prefer offshore bidding zone set up. It would be interesting to see how the model differentiates between these two set ups and see what proportion of such projects would go into these two set ups. Also, how the model would consider the uncertainties associated with the recent political discussions associated with Brexit and its consequences on the North Sea offshore hybrid project set up.

The distinction between 'Near shore – Home Market' zone and 'Far-shore – OBZ' at 50 km from shore is not in line with what is actually being built. We recognize that there needs to be some simplification in the model, but would argue that 70-80 km from shore reflects more what is seen in the North Sea. In the UK, many radially connected offshore wind farms are even further from shore.

32. What do you think about the Hybrid Heat Pump innovation & its relevance to the scenario model? (rank 1 to 10 - 10 most satisfactory)

6

33. In your view, are the assumptions on the Hybrid Heat Pump methodology reasonable?

- Yes
- No

If not, please provide us an alternative source (should be reliable and cover 2050 time-horizon)

We don't understand why the prosumer heating is only provided by hybrid heat pumps. Why pure electric heat pumps are not modelled?

Also, from our understanding to get a better picture of heat demand ENTSOs perform regression analysis. It is said that this is used to understand the relationship between temperature and heat demand. However, the model is trained on years 2008 to 2013. We suggest to consider a longer period expanded to 2020 for instance, in order to get a longer timescale

34. How could the methodology for hybrid heat pumps be improved for the next cycle? Please explain

It is not clear how the flexibility provided by heat pumps especially the electric heat pumps would be assessed, , taking into account cost-effectiveness criteria.. This will be a major contributor to demand side response in the future. It would be interesting to get insights on the contribution of heat pumps to flexibility in the coming cycles. Also, Why the electric heat pump in the methodology is not connected to the electricity grid (node)? Is it an illustration error?

35. Do you find the assumptions on the H2 steel tanks methodology appropriate?

- Yes
- No

If not, please provide us an alternative source (should be reliable and cover 2050 time-horizon)

No views

36. What are the most important modelling innovations that you would like to see in the next cycle? Please explain

One would be to include the distribution grids to the modelling. Our understanding is that the distribution grids are modelled in a very simplified manner in the current version and also does not expand in the future. Considering the huge renewables uptake that we foresee and 70 % of this will be connected to the distribution grid by 2030, it is important to include this in the TYNDP scenario building. Furthermore, the growing capacities of EV charging stations, heat pumps and some electrolysers are going to be connected to the distribution grid. This should be kept in mind while developing the modelling methodology for TYNDP exercises.

Another missing element in the TYNDP scenario exercise is the cost perspective of each scenario. Our understanding is that ENTSOs estimate the cost for each scenario, however, do not publish it considering that this might mislead stakeholders as this doesn't give a comprehensive/correct picture. We urge ENTSOs to improve the cost estimation methodology and publish this cost perspective for better information of the readers.

Eurelectric pursues in all its activities the application of the following sustainable development values:

Economic Development

- Growth, added-value, efficiency

Environmental Leadership

- Commitment, innovation, pro-activeness

Social Responsibility

- Transparency, ethics, accountability

Union of the Electricity Industry - Eurelectric aisbl
Boulevard de l'Impératrice, 66 – bte 2 - 1000 Brussels, Belgium
Tel: + 32 2 515 10 00 - VAT: BE 0462 679 112 • www.eurelectric.org
EU Transparency Register number: 4271427696-87