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Ember response to the ENTSO-E / ENTSOG TYNDP 2024 storylines consultation

On 4 July 2023, ENTSO-E and ENTSOG published their Storyline Report and several key underlying data sets and modelling methodologies as a first deliverable in the formal process for TYNDP 2024 scenario building. All stakeholders were invited to provide feedback until 8 August 2023.

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Priority Comments

- Ember commends efforts to develop a transparent gap closing methodology. However, we recommend the decision to reduce demand in any given sector should be based on transparent assumptions and consider the consequences on other sectors/ carriers. Ember also urges the “before” scenario data should be provided, as well as the resulting input data after gap filling.
- Final energy demand in DE and GA scenarios is higher than in many leading net-zero scenarios due to an assumed slowing of the pace of demand reduction. This increases the supply-side challenge to provide clean energy and potentially results in over-sized (and more costly) energy infrastructure.
- Electrification levels are low compared to 1.5C aligned pathways. The GA scenario is an extreme outlier and while the DE scenario is more representative of leading transition scenarios, it is by no means a high-electrification scenario as it is sometimes interpreted.
- Ember expresses significant concern regarding the prices used for fossil fuels. Several recent sources, including the European Commission, contain price projections that are more than twice those proposed in the draft TYNDP 2024 storylines.
- Ember expresses concern that a number of countries with a high renewable potential see a decrease in their maximum trajectories compared to the TYNDP 2022 results. Additionally, the 2030 maximum value for solar in the EU is lower than SolarPower Europe’s recent estimates based on a business-as-usual scenario. Ember urges ENTSO-E not to confine the long-term renewables trajectories by political considerations and to leave sufficient room for scenario divergence.
- Ember continues to commend the transparent definition of a carbon budget in the TYNDP. However, it remains unclear if and how this constrains the scenarios and impacts planning, and we strongly urge the ENTSOs to incorporate stricter enforcement of the carbon budget into the storylines and scenario development. Additionally, we disagree with the extrapolation of the carbon budget until the year 2100, as relying on negative emissions to recover overshoot post-2050 will have significant implications for infrastructure planning pre-2050 as well as inviting further climate risks that cannot be ignored.

Scenario Strategy & Storylines

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

Ember welcomes this provision of a detailed demand dataset at the storyline stage of this TYNDP cycle, allowing a quantified assessment of the storyline assumptions and inputs.

In our opinion it is logical and appropriate to compute a single scenario for 2030 given the proximity and the greater clarity on EU targets. The inclusion of a 2035 snapshot is welcome because we agree with the ESABCC that the EU should produce a 2035 climate target (in addition to 2040). This is also required as part of the EU's next Nationally Determined Contribution (NDC) due in 2025. Furthermore, several critical climate milestones need to be achieved in Europe by 2035 to align with the Paris Agreement, with power sector decarbonisation being the most pressing.

From 2040 onwards, it is insufficient to have only two storylines (deviation scenarios). European energy strategy decisions can not be (and perhaps never were) simplified into a dichotomy between distributed and centralised technology choices. The past two years have shown that global shocks can rapidly change Europe's energy situation and political priorities, climate ambition included. It is our view that a scenario with increased climate ambition should be created. This scenario would explore the possibility of more transformative change in the energy system, and results in faster mitigation of emissions, reducing
emissions by at least 90% by 2040 in line, with the ESABCC's carbon budget advice.

At the very least, additional sensitivity analysis is needed beyond high and low growth scenarios. There are many sources of uncertainty in the future of the energy system, and these can only be robustly planned for using multiple scenarios combined with sensitivity analysis. As such, we recommend going beyond the Agency for the Cooperation of Energy Regulators (ACER) framework guidelines which require a qualitative risk assessment of each scenario (paragraph 27) by producing quantitative sensitivity analysis. Two input assumptions present obvious candidates for sensitivity analysis. Firstly, the price of gas, which is assumed to decrease on a smooth
trajectory, but in reality is subject to volatility and shocks (we note that ACER also recommends exploring higher gas scenarios in their opinion No 06/2022 on the draft TYNDP

2022 scenario report). While the price of gas is a key sensitivity, this should not become a driver to differentiate between scenarios, as Europe will continue to be exposed to international fossil fuel markets until fuel is phased out. Secondly the impact of weather extremes. As climate breakdown worsens, and the frequency of extreme heat waves and cold spells increases, each major scenario (storyline) should be tested for its resilience to these. This should cover, but not be limited to, the cooling requirements for thermal plants, the resilience of gas and power transmission, impacts on weather-dependent renewables, and the reaction in energy demand for heating or cooling. It is noted that scenario variants with higher carbon budget overshoot may be more vulnerable to these extremes, especially if the background storyline reflects a global failure to constrain emissions before mid-century.

Regarding the DE and GA storylines, in our view neither are fully self-consistent.

Firstly, a distributed vs centralised evolution of the energy system is no longer the principal axis of decision making. While Europe's energy strategy can't be simplified into any single binary choice, a more relevant axis for scenario definition (and decision-making) in view of recent geopolitical events would be domestic versus non-domestic sources of energy. It is noted that the existing storylines have been adapted to incorporate this but more could be done.

Secondly, a choice has been made to align a preference for distributed technologies with domestic energy production, and vice versa, a preference for centralised technologies with a more open attitude towards global energy trade. It is not clear why these two variables should necessarily be correlated. Centralised energy production can be domestic (large nuclear, offshore wind, large-scale solar, renewable district heating), and likewise a distributed energy system can still be reliant on non-domestic energy sources or material resources (imported solar panels, individual gas heating, imported small modular reactors). The alignment of the DE scenario with energy independence has created a counter-intuitive approach to offshore wind. This technology would play a huge role in a highly-domestic and highly electrified system, such as that described by the DE storyline. Yet, this technology is limited in the DE scenario compared to GA, presumably because it is classified as a centralised rather than a distributed technology. This is one example of a technology that could be further utilised in a higher ambition deviation scenario that prioritised a genuinely technology neutral approach rapidly mitigating emissions by 2040.

A risk-based approach to storyline development, where different types of risk are balanced across different storylines, would be a useful framework going forward. An approach that balances risk across storylines (including societal, technological and climate risk) would be more effective at exposing trade-offs and therefore better suited to addressing real strategic choices faced by decision-makers. This would facilitate infrastructure planning that has the best chance of delivering for likely futures while mitigating the worst risks in any single scenario.

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

Yes

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

We commend the ENTSOs on the publication of data with the storylines (which was not the case in previous cycles) which is far more transparent and covers all sectors in detail.

Further steps could be taken to improve the accessibility and the quality of the datasets provided (such as a more intuitive user interface in the energy transition model). We have found multiple inconsistencies across the supply and demand datasets provided that have made it more difficult than it should be to analyse these scenarios.

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:

The storyline report states that "ENTSOG and ENTSOE use a top-down methodology to identify and define contrasting political, societal and technology underlying choices – so called 'high-level drivers'". However, the Green Ambition driver is not used in this way. Rather than reflecting contrasting choices, only one set of climate targets is implemented (2050 climate neutrality and 55% GHG reductions by 2030). As a result of these constraints, in previous TYNDP cycles it has not been possible to remain within a Paris compatible GHG budget by 2050 (by the ENTSO's own measure) without significant overshoot. We believe that contrasting choices should be applied to this driver in the form of a storyline that more rapidly mitigates emissions after 2030, minimising the carbon budget overshoot. Such a variant would simultaneously minimise climate risk and the technological risk that is implicit assuming that large-scale negative emissions can be deployed post-2050. These risks associated with carbon budget overshoot have been chronically under-appreciated by previous TYNDP cycles. A higher ambition scenario would anticipate a 2040 climate target between 90-95% emissions reduction, as recommended by the ESABCC, and align with the expert consensus that power sector decarbonisation must be achieved in the 2030s.

The other drivers are logical and useful. As mentioned in our response to question 1, the driving force of the transition is no longer predominantly a question of centralised versus decentralised, but domestic versus non-domestic. The problem with the existing storyline development framework is not with the choice of drivers, but how they are combined into only two variant storylines using correlations between the drivers which are not fully explained or justified. This leads to inconsistencies within storylines. For example, it is not clear why the combination of drivers for the DE scenario would lead to a lower deployment of offshore wind (see answer to question 4). Two examples are offshore wind and hybrid heat pumps. Similarly, in the GA scenario it is not clear why the combination of drivers result in a stronger market for hybrid heat pumps over more efficient pure-electric alternatives.

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

We commend the efforts to develop a transparent methodology to address the gap between available 2030 plans and what is required to comply with EU targets. In our view it is a good starting point, but overly simplistic, and important details are missing.

The choice of sector / carrier pairs for further reductions in consumption will be key. It is not clear how their 'decarbonisation potential' will be judged. We would recommend assigning high potential to sectors / carriers with the lowest CO_2 abatement cost, i.e., where low cost and proven decarbonisation options are available. This would be consistent with the modelling objective to minimise costs.

Furthermore, the decision to reduce demand in any given sector should be based on a transparent set of assumptions with a supporting hypothesis. It's also important to consider the consequences on other sectors / carriers. For example, reducing energy demand in road transport could be achieved by either reduced passenger kilometres or accelerated electrification of the vehicle fleet. The former would result in higher energy demand for public transport, while the latter would boost electricity demand for EV charging (and also power system flexibility).

Finally, the “before” data should be provided as well as the resulting input data after gap filling. Only this would permit full scrutiny of the process. The expert advice from the Working Group Scenario Building should also be made available.

Demand Figures for DE & GA Scenarios

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

10 Do you think the demand figures within DE & GA scenarios are consistent with their storylines?

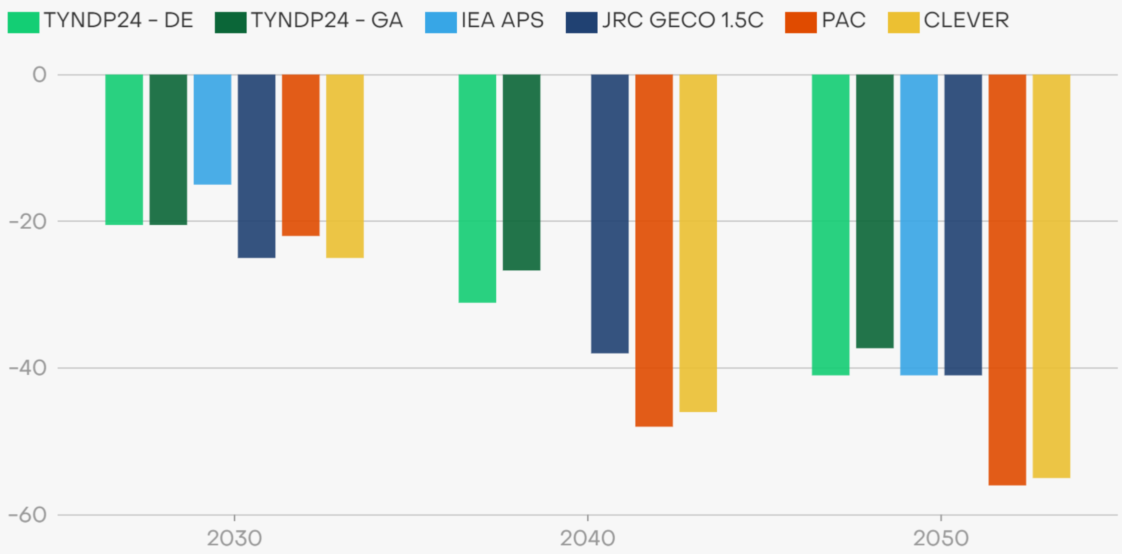
No

If you selected No, please explain:
It is noted that this question relates to the suitability of demand figures for the storylines, while our answer highlights broader inconsistencies with the expert consensus as well as the storylines.

Final Energy demand
It is a welcome development that all scenarios will meet binding energy efficiency targets by 2030 Energy Efficiency Directive (EED). However, after 2030, it is not clear what determines the level of energy consumption. The energy demand values provided for 2040 imply that the pace of energy savings / efficiency improvements will slow dramatically in the 2030s. In order to reach the EU energy efficiency target, final energy demand must fall below 9060 TWh (including international aviation). This requires an average annual reduction of 2.1% between 2019 and 2030. Energy demand for equivalent sectors in DE / GA scenarios falls further to 7850 / 8350 TWh by 2040. To reach these levels, annual reductions of just 1.4% (DE) or 0.8% (GA) are required between 2030-2040. Both scenarios see the pace of savings increase again to 1.6% per year post-2040.

Final energy demand reduces more slowly than in other leading scenarios

Reduction in final energy demand vs 2019 (%)



For the purpose of this comparison, the scope of final energy demand includes final energy consumption in industry (not including feedstocks), buildings, agriculture, and transport (including bunkers).

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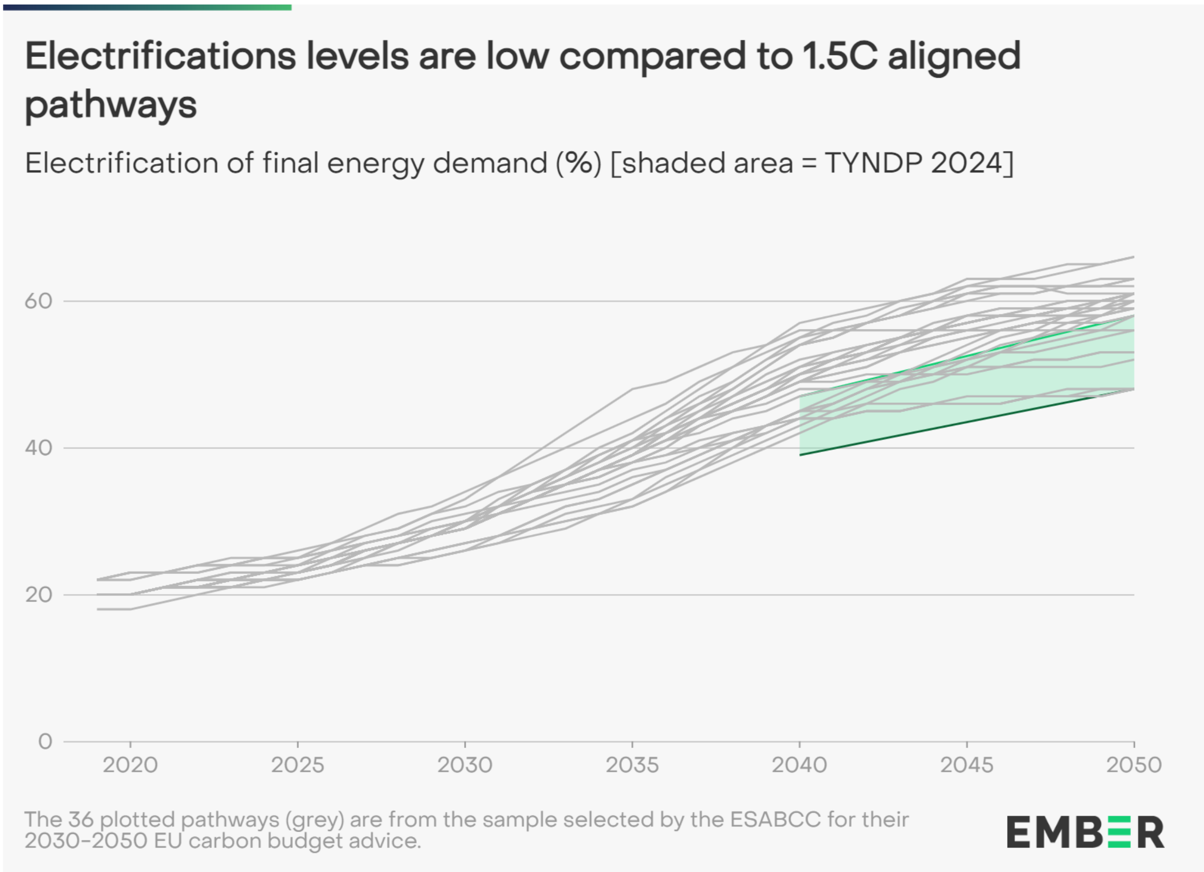
The assumed slowing of progress between 2030 and 2040 - particularly in the GA scenario - results in a final energy demand in 2040 and 2050 that is higher than many leading net zero scenarios, increasing the supply-side challenge to provide clean energy and potentially resulting in over-sized (and more costly) energy infrastructure. By 2040, the DE and GA scenarios reduce final consumption by 31% and 27% compared to 2019. In comparison, the JRC's GECO (1.5C scenario) already sees a 38% reduction by 2040, significantly more than either DE or GA.

By 2050, demand reductions in DE and GA are 41% and 37%. Both the IEA Announced Pledges Scenario (consistent with 1.7C global heating) and JRC GECO (1.5C scenario) foresee a 41% reduction, in line with DE but out-performing GA. Alternative scenarios focused on a circular economy and the concept of sufficiency show that it's possible to reduce consumption even further. Both the PAC scenario by CAN Europe and the CLEVER scenario describe how it is possible to achieve almost 50% reduction already by 2040, and higher than 50% by 2050. Indeed, if the pace of demand reduction required to hit 2030 targets (2.1% per year) were maintained post-2030, the result would be a 48% reduction by 2050, exceeding the IEA and JRC scenarios and coming close to the PAC and CLEVER scenarios.

Electrification

A rapid increase in direct electrification is a core feature of any credible pathway to net zero. The electrification of final energy demand in 2040 is projected to be 47% and 39% in DE and GA scenarios respectively. In their recommendation on a 2040 climate target and GHG budget for 2030-2050, the ESABCC selected a subset of 36 scenarios (from a sample of over 1000). These scenarios are considered feasible and in line with a global 1.5C carbon budget (50% probability, with no or limited overshoot). The ESABCC find that across these scenarios by 2040 'electricity accounts for at least 42% of final energy demand'. In other words, direct electrification by 2040 is too low in the GA scenario (39%) for it to be considered feasible according to the criteria established by the ESABCC. Furthermore, by 2050 the vast majority of scenarios analysed by ESABCC exceed 50% direct electrification, with more exceeding 60% than remaining under 50%, while GA only reaches 48% (DE is 58%). In this metric it is clear that the GA scenario is an extreme outlier in levels of direct electrification. The DE scenario is more representative of leading transition scenarios, but is by no means a 'high-electrification' scenario, as it is sometimes interpreted.



It is claimed in the storyline report that the scenarios ‘draw extensively on the current political and economic consensus’ and that the two deviation scenarios ‘cover a wide range of possible future evolutions of energy infrastructure’. However, it is apparent that the parameter space for genuinely high electrification is neglected, despite being a firm feature of the economic consensus and being well represented in alternative transition scenarios (such as the PAC scenario and Ember’s New Generation study). This brings into question the claim that the scenarios are developed with a technology neutral approach. Our concern is that infrastructure planning based on these two scenarios would inevitably bias the system towards high gas consumption and low electrification relative to the expert consensus.

Methane demand

It is noted that methane demand (excluding that used for power generation) is reduced compared to the TYNDP 2022 by approximately 18% in 2040 and 30% in 2050 across the scenarios. This improves the credibility of both scenarios as decarbonisation pathways.

However, the reduction in methane demand remains too slow. In particular, demand for fossil methane remains high in both scenario in 2040, and considerable demand remains in the GA scenario in 2050, which is difficult to reconcile with the goal of carbon neutrality. Full detail in the final scenarios is required around the need for CCS or negative emissions technology in 2050 (for carbon neutrality) and beyond (to offset the resulting carbon budget overshoot).

EU methane demand (excluding power generation) is only reduced by 44-55% by 2040 and 67-74% by 2050. It does not seem logical that any economically optimised pathway would result in such high levels of residual gas consumption (and emissions) in 2050. This would require expensive mitigation, as opposed to more efficient clean electricity or additional efficiency / circularity. Greater differentiation between scenarios should be explored by reducing (fossil) methane demand to zero in one scenario by 2050, and the potential to reduce methane consumption further by 2040 should be reassessed. Alternatively, a third, higher ambition scenario should be introduced that prioritises rapid mitigation of emissions (at least 90% GHG reduction by 2040) and does not rely significantly on carbon capture and storage to remain within the carbon budget. Recent research shows that it is possible to reduce all fossil gas consumption in the EU (including the power sector) by 90% by 2040, phase out gas completely by 2050 “while maintaining today’s level of industrial production and fully ensuring security of supply, without disruptive behavioural changes” (Agora Energiewende, “Breaking free from fossil gas”, 2023).

Considering developments in clean technologies, the final uses of methane, in a nearly-decarbonised system, are likely to be in high-temperature industrial processes, combined heat and power plants, and backup power. The remaining methane demand in 2050 in TYNDP 2024 scenarios is even harder to justify as it is not restricted to these sectors. Instead, it is foreseen that significant amounts are still used in buildings (space heating and hot water) and transport sectors (heavy duty vehicles). These end-uses already today have mature and cost-effective decarbonisation solutions in the form of electric heat pumps and electric drive-trains. To assume these sectors still consume methane in 2050 is to radically underestimate the transformative potential and the popularity of electrified technologies.

Households and buildings account for 40-45% of remaining methane demand in 2050. Within that, it is incomprehensible that methane still provides 12% of energy demand for space heating in buildings and households in both scenarios in 2050. Especially if this is fossil methane and in particular, in the DE scenario, where residential and tertiary sectors allegedly “transition towards renewable heat provided by all-electric heat pumps”. The use of methane in building and household appliances only decreases by 38% at EU level (DE & GA) by 2050. At the same time, it appears counterintuitive that electricity demand for household appliances also decreases in both scenarios. The ENTSOs should further justify this trajectory and explore whether any potential for faster electrification is being overlooked here in order to displace gas consumption further.

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

No

If you selected No, please explain:

Heat pumps
Pure-electric heat pumps are set to become the dominant technology for individual (non-networked) heating systems. However, conventional/fossil technologies (methane, oil, and hybrid heat pumps with methane) still supply a significant share of households in 2050, averaging 9-10% across all countries. In our view, it is difficult to justify such a prolonged use of methane (especially fossil) for low-temperature heating in either scenario, especially DE, given the carbon neutrality constraint and the maturity of electric heat pumps. In our view, pure-electric heat pumps should fully supply non-networked space heating and hot water to buildings by 2050 in the DE scenario, and a much higher share in the GA scenario. Related to this, the need for hybrid heat pump systems is overestimated. Hybrid systems account for a small share of sales today. The word ‘hybrid’ appears only eight times in the IEA’s flagship Future of Heat Pumps report, and it is noted that their uptake, while justified in some specific circumstances, would hamper the full decarbonisation of buildings. Despite surging sales across Europe, the upfront cost of heat pumps is identified as a major deterrent to their uptake by the European Heat Pump Association. It follows that the even higher cost of hybrid systems (two heating systems in one) would create an even larger deterrent. It is recommended that the ENTSOs remove all fossil/methane heating systems from at least one scenario by 2050. In addition, they should provide further justification for the use of hybrid systems, including the specific circumstances in which they represent a more economic and secure option for consumers in comparison to pure electric systems. In the case of buildings with large heating demand or low-efficiency, it should be explained why pure electric solutions, considering likely advancements in technology, still could not deliver sufficient heat.

Battery electric vehicles

Electrification of transport can go further in the DE scenario, particularly in cars, buses, and trucks. Clean hydrogen will be an expensive and limited commodity which should be prioritised to decarbonise end-uses without alternative options. The average national share of electric cars in the DE scenario in 2050 is 91%. This would be closer to 100% in a scenario that truly prioritised distributed, electrified technologies. The electrification of heavy duty vehicles, especially buses, is accelerating globally. In Europe, all-electric buses accounted for 6% of sales in 2021, second only to China with a 26% share (IEA). BloombergNEF forecast that half of the world's bus fleet will be electric by 2032. Battery electric bus sales in Europe already dwarf fuel-cell electric sales, 4150 vs 99 in 2022. It therefore appears pessimistic and in defiance of these trends that the average share of electric buses is only 50-65% in GA and DE scenarios in 2050, while an average of 25% of buses are powered by gas in the supposedly highly-electrified DE scenario. It is even harder to explain why a significant share (around 5-12%) of heavy-duty vehicles still run on methane in both scenarios in 2050, especially if this is fossil methane. Even if this is biomethane, it is unlikely this will be competitive with the electric alternative. We recommended that both scenarios take into account the latest technological trends and market data on the growth in battery electric heavy duty vehicles and ensure fossil gas is completely phased out of this subsector by 2050 in all scenarios.

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

Yes

Supply Figures for DE & GA Scenarios

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

RES trajectories
Overall, the trajectories appear reasonable, but Ember expresses concern regarding the maximum potential for renewable deployment in certain countries. This is particularly in view of the stated ENTSO-E methodology which defines the maximum range by that across published studies.

Ember comparisons to other published studies, and perhaps most importantly to the previous TYNDP, and demonstrates instances where this is certainly not the case.

- Ember expresses concern that a number of countries with a high renewable potential see a decrease in their maximum trajectories when compared to the TYNDP 2022 results. For instance, maximum wind and solar deployment in Portugal decreases from 66 GW (TYNDP 2022) to 25 GW (TYNDP 2024), and in Spain from 343 GW to 269 GW. This is also the case in many currently coal dependent countries such as Bulgaria (40 GW to 14 GW), Romania (84 GW to 30 GW), Hungary (48 GW to 24 GW) and Czechia (49 GW to 23 GW), amongst others.

Max RES trajectories in TYNDP 2024 storylines is lower than installed capacities in TYNDP 2022 scenarios

Wind and solar capacity (GW)

TYNDP 2022 figures are the maximum capacity installed in the country across the scenarios. TYNDP 2024 figures are the maximum of the high trajectories.

- Furthermore, the maximum level of onshore wind deployment suggested for the TYNDP 2024 is 919 GW, while the maximum deployment figures from the TYNDP 2022 is 960 GW. As an example, the TYNDP 2022 DE scenario saw 15.7 GW installed in Hungary in 2050 - by contrast, the maximum trajectory given in the TYNDP 2024 storyline dataset is just 334 MW.

If decisions are taken that contradict the methodology, this should be transparently documented in the report. That being said, Ember urges ENTSO-E to not confine the long-term RES trajectories by political considerations but continues to use published studies for reference.

Additionally, Ember notes that the 2030 maximum value for solar in the EU is lower than recent estimates from SolarPower Europe. The ENTSO's high trajectory for the EU reaches 783 GW in 2030, similar to SolarPower Europe's Medium ('business-as-usual') scenario (736 GW) and far below its High scenario of 947 GW. All values are given in AC. Ember encourages the ENTSOs to leave sufficient room for scenario divergence, particularly in view of projections in market outlooks.

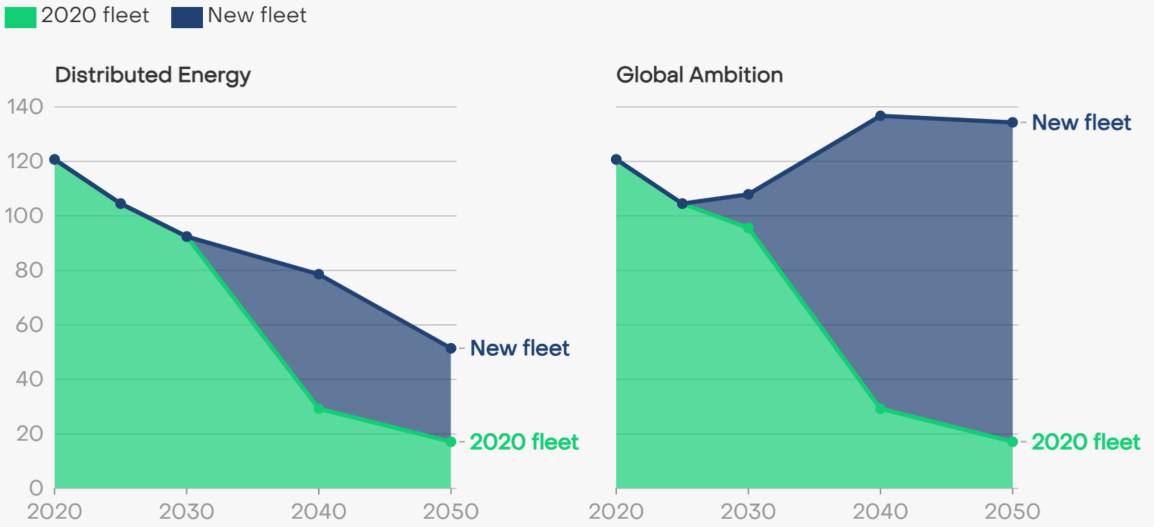
Finally, Ember would appreciate clarification in the final storylines report if battery capacity from V2G enabled vehicles is included in the category of "non-market/rooftop" batteries.

Nuclear

Both DE and GA scenarios assume significant development of new nuclear capacities. Ember estimates that with moderate lifetime extensions, approximately 17GW of the existing European fleet could still be operational by 2050. The DE scenario's fleet of 51 GW therefore implies a substantial 34 GW of new capacity in the next 27 years. The GA scenario's fleet of 134 GW implies a staggering 117 GW of new capacity over the same period. We seriously question how representative these scenarios are of the likely futures for European nuclear, particularly given huge time delays and cost overruns in recent projects. The GA scenario appears to be aligned with the most optimistic scenarios from national TSOs regarding nuclear, for example, RTE's N03 scenario (FR) and National Grid's Consumer Transformation (GB). In the interest of providing differentiated scenarios, one might expect the DE scenario to be more aligned with the least optimistic outlooks for nuclear. However, the numbers are more aligned with middle-of-the road scenarios that still involve significant expansion. Ember's New Generation study concluded that the cost-optimal pathway to decarbonise Europe's power system in the 2030s doesn't feature any investment in new nuclear.

Both scenarios envisage significant new nuclear deployment in the 2030s

Total EU installed nuclear capacity (GW)



The evolution of the existing (2020) nuclear fleet is based on Ember calculations, taking into account announced phase-out dates and lifetime extensions (World Nuclear Association data). Where official dates are unavailable, 50-year lifetimes are assumed for nuclear units.

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14 In your view, are the technology costs appropriate?

Ember considers the technology costs to be reasonable and the sources sound. However, there are cases where the costs for a technology are higher in 2050 than in 2030. This appears to be due to an error in the GA 2050 figures. The numbers seem to be incorrectly linked to the Best Estimate 2040 figures, as opposed to those for 2050 (while the 2050 DE figures are correctly linked to the 2050 Best Estimate values). It is unrealistic that costs in 2050 (in real terms) would be higher than those in 2030 or 2040. This should be a check applied to all technologies across the scenarios.

Ember notes that technology costs for generation technologies with CCS are absent from the data sheet. Given that the integration of CCS is a key defining feature of GA, this is considered to be a major exclusion from the public consultation.

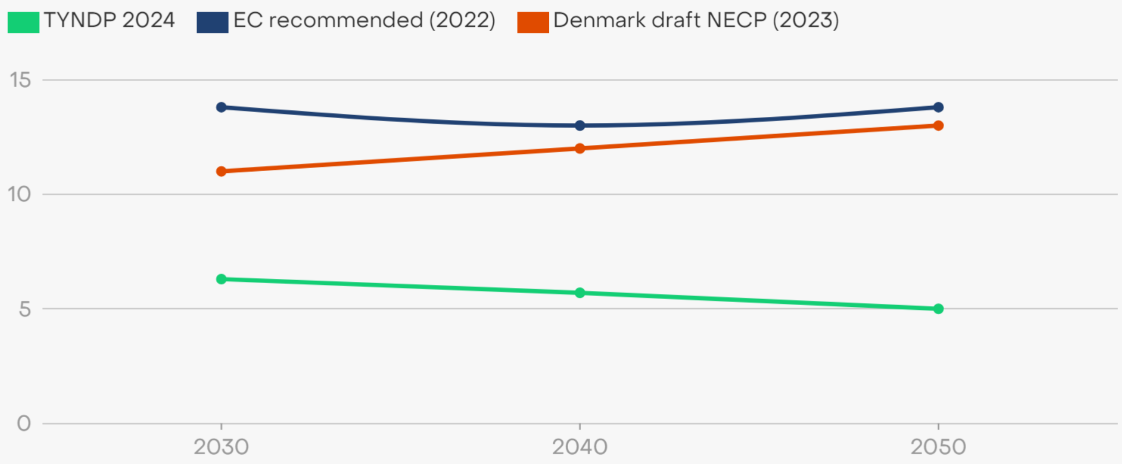
15 In your view, are the prices (presented in the 20230704 – Draft Supply Inputs for TYNDP 2024 Scenarios.xlsx, sheet 3) appropriate?

Ember expresses significant concern regarding the prices used for fossil fuels. While we understand that the prices are taken from a reputable source (IEA 2022), we do not believe them to be realistic for Europe. Indeed, price projections from the European Commission, provided to capitals in 2022 for their use in the updated National Energy and Climate Plans are more than double those included in the draft TYNDP 2024 storylines. The former are listed in Annex 2 of certain NECP updates as €473/toe in 2030 and 2040, and €494/toe in 2050. This works out to about €11.30-11.80/GJ, far below the prices proposed for the 2024 TYNDP of €6.3-5/GJ.

The projected natural gas prices provided by the European Commission compare favourably with recent projections made by Denmark and the UK. Denmark's draft updated NECP provides prices for natural gas as €11-13/GJ while prices in a recent report from the UK's Office for Budget Responsibility* never drop below ~€11/GJ between now and 2050 (this was worked out assuming a conversion rate of £1=€1.16). Again, these are more than double the price proposed for the TYNDP 2024 (even without taking into account the difference in base year for prices, which would inflate the prices quoted by Denmark).

TYNDP projections appear to severely underestimate the price of natural gas, compared to more recent and Europe-centric scenarios

€/GJ



Source: EU Recommended parameters for reporting on GHG projections in 2023, Denmark's draft updated NECP · Note the base year for prices is different between sources. EU recommended parameters are in Euro'20 and projections in Denmark's draft NECP update are in Euro'16. The base year for prices proposed for the TYNDP 2024 storylines is unclear.

Ember strongly urges the ENTSOs to address this modelling bias in favour of gas, particularly in light of the political, social and economic consequences from prolonging gas dependencies. We propose that the TYNDP 2024 uses the price projection provided by the European Commission for all fossil fuels.

On the costs of imported green ammonia/hydrogen: Ember requests clarity in the final storylines report on whether the figures in Sheet 3.3 include costs associated with transport such as import terminals and shipping. It is assumed that prices for hydrogen produced within the EU will be calculated through the scenario modelling and published in the scenario report, as these are not present in the storyline documentation. Ember urges transparency and clarity on hydrogen costs, given the degree of attention and contention on the issue of hydrogen use and supply.

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

Not Answered

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

No

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

Due to the approach adopted, extra-EU hydrogen imports have been maximised. Ember disagrees with this approach to determine maximum potentials for fuel imports as it is considered incompatible with the EU's priorities of energy independence, especially following Russia's invasion of Ukraine.

Ember also considers the high value of potential hydrogen imports from Ukraine to be unrealistic in the near term (2030) and a risky assumption in the longer term, particularly when this makes up almost 25% of the total import potential.

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)

Not Answered

If you selected No, please specify:

Ember notes that the figures in the tab “EU” do not match those in the tabs “DE Total” and “GA Total”. For the purposes of feedback provided on the draft storylines, it was assumed that the figures in the latter two tabs are correct and those in the “EU” tab incorrect.

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

No

If you selected No, please specify:

The degree and style of difference between the storylines appears to have remained relatively consistent with the TYNDP 2022 storylines, except on hydrogen (difference between GA and DE more pronounced), solids in 2040 (GA much higher, whereas previously no difference), and liquids in 2050 (difference was more pronounced in TYNDP 2022 but now there is almost no difference).

Ember welcomes the stronger differentiation in scenarios, particularly regarding hydrogen which is one of the energy carriers that is perhaps most crucial for evaluating electricity and gas infrastructure (the stated primary purpose of the TYNDP scenarios). However, the split between imported hydrogen and domestic production appears inconsistent with the storylines. GA is understood to continue to see a role for imports, and the draft figures on hydrogen demand show that imports provide 51% of the supply in 2040 and 49% in 2050. One would expect that imports in the DE scenario, which prioritises energy independence, to be far lower; however, imports make up 45% of supply in 2040 and 40% in 2050. This is considered to be inconsistent with the storyline and, particularly in light of the recent energy crisis which prompted the EU's push towards reducing import dependencies, Ember urges the ENTSOs to reduce the portion of imported hydrogen in the DE scenario.

Ember expresses significant concern that the difference in electricity demand between the two scenarios has remained negligible - just over 10% in 2040 and 2050 - and the difference in methane demand has actually reduced compared to the TYNDP 2022.

Furthermore, the draft TYNDP 2024 storylines sees a 38-50% (GA and DE, respectively) reduction in methane demand between 2015 and 2040, a far cry from what is likely needed for the EU to remain within its greenhouse gas emissions target (expected in 2024). Ember urges the ENTSOs to increase the divergence between the two scenarios, where one sees comparatively higher levels of electricity demand and lower demand for methane. This would better allow an assessment of trade-offs between different pathways while also anticipating the upcoming EU 2040 greenhouse gas target.

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? Specify:

Ember expresses concern that the input data for the hydrogen reference grid is directly and exclusively taken from national gas TSOs. This approach lacks transparency and legitimacy. Indeed, the resulting costs of the hydrogen candidate projects are likely to be underestimated, with the highest CAPEX being only €81.1 million and an average of less than €15 million.

Ember considers that splitting the CAPEX between repurposed and new hydrogen pipelines with a split of 75% to 25%, respectively, creates an unrealistic bias in the modelling and results in favour of hydrogen pipelines.

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:

Not Answered

Modelling Methodology and Assumptions

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

No

If you selected No, please provide an alternative source:

First, while Ember continues to commend the transparent definition of a carbon budget in the TYNDP, it remains unclear if and how this constrains the scenarios and impacts planning. We strongly urge the ENTSOs to incorporate stricter enforcement of the carbon budget into the storylines and scenario development. At the very least, the full implications of a carbon budget overshoot should be explored and presented transparently.

Second, we disagree with the extrapolation of the carbon budget until the year 2100. While it is theoretically true that negative emissions can recover the overshoot post-2050, such a strategy will have significant implications for infrastructure planning pre-2050, and could increase climate-related risks. While the transparent reporting of the carbon budget overshoot in previous editions of the TYNDP was welcome, stronger constraints should be introduced to limit gross emissions between 2030 and 2050, and hence budget overshoot. This could be done in at least one deviation scenario, or a separate higher ambition scenario. Where a significant carbon budget overshoot is still permitted, the ENTSOs should expand fully in the final TYNDP report on the consequences for infrastructure both pre and post-2050.

Furthermore, Ember is disappointed to note there has been a minimal change in total fossil demand between the TYNDP 2022 and TYNDP 2024 (draft), implying that we can again expect a significant overshoot of the carbon budget before 2030 in both scenarios. This appears incompatible with the alignment of TYNDP scenarios with the Europe Climate Law and the upcoming 2040 greenhouse gas target.

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

Not Answered

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

Not Answered

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

It is unclear from the slides provided whether a portion of the fleet or all EVs are considered to be V2G enabled and from what date this technology is considered to be functioning. Additionally, it is unclear if all vehicles/ charging stations are equipped for smart charging. These two elements have significant implications for demand side flexibility and peak demand. Therefore, Ember urges clarity on these points in the final storylines report.

25 How could the methodology be improved for the next cycle? Please explain:

EV charging patterns should be explored which provide greatest synergies with the power system, in anticipation of incentives to improve power system flexibility and limit the use of fossil fuels for power generation.

26 What do you think about the P2G innovation & its relevance to the scenario model? (rank 1 to 10 - 10 most satisfactory)

Not Answered

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

Not Answered

28 How could the P2G methodology be improved for the next cycle? Please explain:

Not Answered

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

Not Answered

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

Not Answered

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

Not Answered

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

5

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

No

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

It is unclear why hybrid heat pumps should be anything more than a marginal technology and therefore the development of a specific methodology is a wasted effort.

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

Not Answered

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

Not Answered

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

Further development of the modelling methodology should concentrate on improving sector coupling, and how improved system efficiency could reduce the need for new infrastructure or dependence on imports. Furthermore, the methodology should be capable of handling changing patterns of consumption that may be increasingly incentivised, and the impact this could have on reducing the overall need for new energy infrastructure. For example, greater demand flexibility in the power system - from both households and commercial consumers -

could limit the need for grid expansion, backup power sources, and backup heating systems based on gas.

About Ember

Ember is an independent, not-for-profit energy think tank that aims to shift the world to clean electricity using data. It gathers, curates and analyses data on the global power sector and its impact on the climate, using cutting edge technologies and making data and research as open as possible. It uses data-driven insights to shift the conversation towards high impact policies and empower other advocates to do the same. Founded in 2008 as Sandbag, it formerly focused on analysing, monitoring and reforming the EU carbon market, before rebranding as Ember in 2020. Its team of electricity analysts and other support staff are based around the world in the EU, UK, Turkey, India, China and Indonesia.