QUESTIONS	ENTSO-E & ENTSOG's ANSWERS
Interested to learn more about P2G configurations. How did you determine the split between grid- and RES-based electrolysis (e.g., Fig. 30)?	In the hydrogen modelling we use four different configurations to capture different market dynamics. These configurations are described in the Scenario Building Guidelines (https://2022.entsos-tyndp-scenarios.eu/building-guidelines/). The way how hydrogen demand is divided in different configurations is scenario dependant and follows the scenario storyline. Global Ambition foresees the highest share of configuration-4 (full market integration, with hydrogen infrastructure). Whereas Distributed Energy focusses a bit more on the decentralised production in configuration 1 and 2. Specific market shares of the configurations per scenario are listed in table 16 and 17 (page 20/21) of the Scenario Building Guidelines.
Do the new scenarios consider the EU Green Deal targets, the new German climate law and infrastructure changes towards h2 readiness?	The National Trends scenario is in line with national energy and climate policies (NECPs, national long-term strategies, hydrogen strategies, etc.) derived from the European targets. Distributed Energy and Global Ambition are designed around scenario storylines to be compliant with -55% GHG reduction by 2030 and net zero by 2050. Furthermore, (retrofitted) hydrogen infrastructure is explicitly modelled in the COP21 scenarios.
It would be great if you could explain further how the scenarios are used for planning the necessary network and grid expansions and reinforcements.	The scenarios will be updated based on the feedback received during the public consultation. The updated scenario report will feed into the TYNDP 2022 development process. The TYNDP process will use scenario input data to assess the infrastructure and the projects submitted by project promoters. The electricity and gas draft TYNDPs are expected to be published in next year for public consultation. The TYNDP report will show how the infrastructures are used in the contrasting pathways offered by the scenarios.
What was the engagement with national competent authorities and national regulators in preparing the scenarios?	Transparency, inclusiveness, and efficiency are key values for the TYNDP process. Several meetings with the European Union Agency for the Cooperation of Energy Regulators - ACER. - have taken place. The detailed list of meetings with stakeholders can be downloaded on the TYNDP website, under the Download section. Link - https://2022.entsos-tyndp-scenarios.eu/wp-content/uploads/2021/10/WGSB-2022_Stakeholder-Meeting-Log.xlsx

QUESTIONS	ENTSO-E & ENTSOG's ANSWERS
Are there significant changes in the main messages of TYNDP 2022 compared to the previous round? If so, what are the biggest changes in the conclusions?	The TYNDP 2022 scenarios are an evolution from the scenarios in the 2020 edition. As a result, most of the takeaways from the TYNDP 2020 scenarios are reinforced in the new edition of the scenarios. For example, regarding the importance of renewable energy like solar, wind, and renewable gas for reducing emissions. Or the increased need for sector coupling (electricity, gas, heat, etc) to achieve the decarbonisation targets. However, there are also differences with the previous scenarios. Based on stakeholder feedback for the previous TYNDP, the new scenarios now explore more diverse pathways with more differentiation between the scenarios. As a result, the new scenarios show that Europe can achieve higher electrification and hydrogen demand, or lower import dependence compared to the previous scenarios.
It seems that EC uses the PRIMES energy model. Is there a link between ENTSOS scenarios and the PRIMES energy model?	ENTSOG and ENTSO-E use their own tools to perform the scenario modelling. More details can be found in the Scenario Building Guidelines (https://2022.entsos-tyndp-scenarios.eu/building-guidelines/). PRIMES is not used for the TYNDP scenarios. However, in deciding on the input parameters (for example commodity prices), assumptions used in PRIMES part of the analysis for the TYNDP scenarios. Furthermore, the outputs of the TYNDP scenario modelling are explicitly benchmarked against the scenarios from the EC (in particular, the Impact Assessment).
Do the scenarios rather represent the most probable outcomes, or do they aim to show extreme paths (for stress tests etc.)?	The scenarios are intended to project the long-term energy demand and supply for the drafting of ENTSOG's and ENTSO-E's Ten-Year Network Development Plans within the context of the ongoing energy transition. They are designed in such a way that they specifically explore those uncertainties which are relevant for gas and electricity infrastructure development. As a result, the TYNDP scenarios should not be considered as a forecast but the rather as different reasonable extreme pathways.

QUESTIONS	ENTSO-E & ENTSOG's ANSWERS
Is heat storage part of the strategy, for example, but not exclusively, coupled with CHP	For this edition of the TYNDP scenarios, a specific modelling step has been introduced to better reflect interactions with district heating networks. The aim is to define the capacity and electricity load profiles of heat pumps installed on district heating networks. With the combination of heat technologies partly considered, the design and load factor of heat pumps have been optimized compared to their equivalent installed at end-user level. With this modelling step we try to capture some of the flexibility that heating networks can provide to the electricity grid. Future editions of the TYNDP scenarios will provide the opportunity to improve these methodologies.
Will the electricity demand time series (hourly data) of the 2022 draft scenarios be released? (as it was for 2020 TYNDP)	The electricity demand time series are not released for the draft scenarios. We still have to factor in global warming in the updated modelling after consultation. ENTSOG and ENTSO-E will investigate if additional information can be published for the updated scenario report.
Do the TYNDP scenarios include data about the hydrogen infrastructure (for transportation) development?	Assessment of the (hydrogen) infrastructure is not the scope of the TYNDP scenarios. The purpose of the scenarios is to provide demand and supply figures to enable the infrastructure assessment that is performed for the TYNDP itself. The electricity and gas draft TYNDPs are expected to be published in next year for public consultation.
The overall modelling topology (slide 22) does not include transmission networks. Will we see competition between hydrogen & power transmission infrastructure?	Assessment of the infrastructure is not the scope of the TYNDP scenarios. The purpose of the scenarios is to provide demand and supply figures to enable the infrastructure assessment that is performed for the TYNDP itself. The electricity and gas draft TYNDPs are expected to be published in next year for public consultation.
Do the scenarios carried out so far have an inertia analysis provided by the type of technology for each country?	The scenarios ensure adequacy on hourly basis across the year for 3 climatic years. It does not analysis closer too real time aspects such as inertia.

QUESTIONS	ENTSO-E & ENTSOG's ANSWERS
To what extent do you think that such a joint scenario building exercise between electricity and gas operators is needed/useful at national level?	Due to the full scenario modelling approach, joint scenario modelling is embedded in the COP21 scenario building. In the data collection for National Trends, the gas and electricity TSOs were asked to align their submission on key topics to ensure consistency in the dataset. ENTSOG and ENTSO-E see the benefit of joint scenario building on a national level as well. Also, to improve the feedback loops between the TYNDP and the national plans.
Could you provide a bit more details on the new climatic database? What will be the new years considered replacing the 1982 1984 and 2007?	The climatic database has been updated. The new climatic years are 1995, 2008 and 2009.
How is H2 as a feedstock modelled? How are existing H2 networks for carrying H2 as feedstock covered? How to merge H2 for both feedstock & energy carrier?	Feedstock (or non-energy use) is included in the modelling of final demand. The energy use for the different application is also shown in the visualisation platform. Regarding existing hydrogen demand for feedstock, Eurostat does not label this demand as hydrogen, but rather as natural gas or other fossil fuel which is used as a feedstock for the hydrogen production. As a result, most of the current hydrogen produced locally in the industrial clusters is not included in the hydrogen figures. This is in particular true for National Trends. Already existing hydrogen infrastructure operated by third parties is not modelled.
When looking at national data (eg France) we can see that gas supply (mainly biomethane) exceeds gas demand in 2050: how can that be interpreted?	The French methane demand in 2050 varies from around 260 TWh (DE draft scenario) to around 420 TWh (GA draft scenario). In 2050 the French methane demand is higher than the French biomethane supply (around 250 TWh, draft scenarios).
Is gas mobility included in ICE?	Compressed Natural Gas - CNG - is included in the Internal Combustion Engine - ICE - category.
Why is the overall energy consumption in transport decreasing in all scenarios?	The shift to electric transportation contributes to energy efficiency as electric motors have a higher efficiency than internal combustion engines. Behavioural changes where consumers actively reduce demand also contributes to reducing the overall energy consumption in transport.

QUESTIONS	ENTSO-E & ENTSOG's ANSWERS
Why hasn't an inertial "Business as usual" scenario been proposed and analysed? We believe that it's useful in order to identify corrective actions to be taken	For the next couple of years until 2025, the scenarios are based on a best estimate from the TSO's. This can be considered a business-as-usual scenario. For the long-term starting in 2030, the National Trends scenario, which is based on national energy and climate policies, can be considered an extension of the current trajectory.
Please comment on the huge difference in forecasted demand for hydrogen in National Trend vs. the other scenarios (slide 30)	The quantification of National Trends is based on the figures collected from the TSOs translating the latest policy- and market-driven developments as discussed at national level. Many national energy statistics do not label the existing hydrogen demand as hydrogen, but rather as fossil fuel demand for feedstock. As a consequence, most of the current hydrogen produced locally in the industrial clusters is not included in the figures for National Trends. In the COP21 scenarios on the other hand, hydrogen demand and production are part of the full energy modelling. This provides the opportunity to give a more comprehensive picture.
Do you allow oil & gas sector to feed into petchem?	In the TYNDP scenarios all customers can have access to the gas delivered by the gas network. In Petrochemical sector oil and natural gas are still foreseen in the upcoming years but faced out over time. In 2050 for Global Ambition methane is low-carbon (biomethane and synthetic methane) by two third and natural gas used in the industrial is combined with CCS. Methane is fully low carbon in Distributed Energy 2050. Oil is included in the "Liquids" category. In 2050, it amounts for 10% of liquids in Global Ambition and 13% in Distributed Energy. Emissions are compensated by LULUCF and CCS.
H2 use in Residential & Tertiary seems quite big in GA. Do you assume EU countries will switch to H2 for heating, cooking, …? What's the rationale behind it?	The TYNDP scenarios are intended to project the long-term energy demand and supply for the drafting of ENTSOG's and ENTSO-E's Ten-Year Network Development Plans within the context of the ongoing energy transition. They are designed in such a way that they specifically explore those uncertainties which are relevant for gas and electricity infrastructure development. One the relevant uncertainties is what will be the role of hydrogen in the built environment. This uncertainty has a direct impact on the need to retrofit high- and low-pressure gas infrastructures. In order to capture this uncertainty,

QUESTIONS	ENTSO-E & ENTSOG's ANSWERS
	Global Ambition assumes a high uptake of hydrogen residential and tertiary heating, whereas Distributed Energy assumes a low share.
Will you continue to develop the possibilities/potentials of District heating in the future modelling?	District heating is already considered and will continue to be considered in the different scenarios.
What about peak demand for gas in slide 31?	Methane peak demand is detailed on page 20 of the TYNDP 2022 Draft Scenario Report (paragraph 4.1.3.1). *The high daily-peak and 2-week demand for methane reflect the changing nature of residential and commercial demand, as temperature-depending space heating typically drives peak methane consumption. As a result, the methane demand for end use during peak days and 2-week cold spells decreases in all scenarios due to efficiency measures with an even further decrease in Distributed Energy, partly due to a higher penetration of electrical heating systems. National Trends observes the most limited change as consumers invest in more traditional technologies, although they are considered less efficient.*
Could you elaborate a little bit more on the quite high electricity demand in slide 32 compared to EC modelling?	For both scenarios, the difference is mostly drive by the transport sector assuming a higher electrification than Commission (e.g., EVs have 15% higher share in TYNDP scenarios than in EC Impact assessment)
Why there are no hybrid in the decentralised scenario?	There is hybrid heating in both scenarios, but market shares are indeed lower in Distributed Energy. The visualisation platform shows residential and tertiary sector market shares for space heating. For the market shares of hybrid heating technologies, it shows the gas part and the electricity part separately.

QUESTIONS	ENTSO-E & ENTSOG's ANSWERS
How do you set the share of hydrogen and e-methane imported from the North-African countries?	Import assumptions from were determined following a dedicated public workshop on energy supply in summer 2021. The import potentials for hydrogen from north Africa (and other regions) have been derived from the existing pipeline capacities which can be retrofitted. There are no synthetic methane imports assumed from North Africa.
Have you considered any development of hydro power generation in the scenarios?	We assume the same hydro development in both scenarios at a level equivalent to the National Trends scenario resulting from national strategies. No capacity development is taken into account beyond 2040 but pump storage cycling may increase
When referring to methane (Figure 8, 2030-->50) demand are you addressing NG, biomethane or both?	On Figure 8 of the TYNDP 2022 Draft Scenario Report, methane includes natural gas, biomethane and synthetic methane.
Biomass supply for energetic use seems to be doubling compared to today. How does this assumption come about?	The biomethane potentials are detailed in part C of the Appendix IX of the TYNDP 2022 Scenario Building Guidelines.
The scenarios show large growth in biomass. How sustainable is this? Is there sufficient feedstock available?	The biomethane potentials are detailed in part C of the Appendix IX of the TYNDP 2022 Scenario Building Guidelines.
Is nuclear accounted as Renewable or Low carbon?	Nuclear is accounted as a low carbon source.
What is the feedstock for the biomethane and where is it produced?	The biomethane potentials are detailed in part C of the Appendix IX of the TYNDP 2022 Scenario Building Guidelines.

QUESTIONS	ENTSO-E & ENTSOG's ANSWERS
Could you expand on how electricity storage is considered? I see HPS and batteries are mentioned. Are you considering other technologies for grid level?	Pure storage technologies taken into account are batteries (utility-scale, prosumer and EV) and pump hydro. With the development of hydrogen production through electrolysis, some similar services are modelled with hydrogen steel tanks and salt caverns.
What challenges do you see for installing the required capacity of solar PV and onshore wind? Available land, NIMBY concerns etc?	Our Executive summary does identify public acceptance for all type of energy infrastructures as a priority challenge to be solved. Scenarios do not aim at proposing policies in that direction but as they help to identify RES, flexibility and grid benefits they can contribute to a better acceptance.
Do you use the large amounts of excess heat from producing hydrogen from renewable electricity?	In the scenarios the heat from producing hydrogen from renewable electricity is not used.
Onshore wind capacity growth seems much higher than offshore wind capacity towards 2040 and 2050. Quid public acceptance and onshore wind retrofitting risks?	We do see public acceptance issues especially for onshore wind and some rebalance between RES technologies could occur in the scenario update based on public consultation.
Have hydrogen storage technologies been considered?	Underground hydrogen storage as well as storage of hydrogen in tanks have been considered in the scenarios.
Why such a massive use of batteries to ensure flexibility?	Battery development is pushed by prosumer and EV. Compared to other studies Distributed Energy and Global Ambition does not foresee a massive increase in battery capacity. In Distributed Energy the combination of utility-scale, prosumer and V2G batteries amount to 110 GW (fig. 21) to be compared to 116-123 GW in EC Impact assessment.

QUESTIONS	ENTSO-E & ENTSOG's ANSWERS
How do you evaluate the incentives for keeping the gas fired generation units alive with 50% reduced full load hours (slide 36)?	The adaptation of the market design is beyond TYNDP Scenario remit.
Could you detail the prosumer behaviour linked to power peak demand in slide 40? (assumptions, breakdown between different solutions)	The prosumer behaviour refers to the development of V2G services and the investment in residential batteries to be combined with rooftop solar in order to minimize the grid connection.
In flexibility, do you include upward demand response e.g., by heat produced by electric boilers and additional hydrogen production during lower power prices?	There is upward demand response from V2G and electrolysers when
Is flexibility a non-optimised output of scenario building, or a constraint based on system ramping needs hence an optimised and cost-efficient output?	Flexibility is a broad concept and the graph only refers to batteries, DSM and peaking thermal units. Pump storage and electrolyser (when combined with H2 other sources or storage) also provides flexibility. The capacity of batteries, thermal units and electrolyser result from a cost-optimized investment loop while DSM and pump storage capacity are predefined based on data collected at national level for the National Trends scenario. The delivered energy then results from a cost-optimized dispatch.
What peakers do your scenarios include for flexibility and what is the capacity for the different types (natural gas plants, hydrogen power generation,...)?	The split of gas units between methane and hydrogen can be found in figures 21 and 22 of the report (underlying numerical values can be downloaded from the scenario website). It depends on the scenario and time horizon. It is link to the relative share of hydrogen and methane finale demand which is a proxy for their respective grid.
With the huge increase in biomethane, PV and wind capacity, what is the impact on the land usage ? Do you see that as a limitation issue?	Rooftop PV and offshore wind does not have the same land impact than onshore wind and large PV farm. The challenge of RES acceptance can go beyond the sole land impact.

QUESTIONS	ENTSO-E & ENTSOG's ANSWERS
DSR is playing a very limited role. With just around 5TWh this accounts for only about 0.1 of final electricity demand. Is there a larger potential to consider?	DSR assumptions derive from TSO best estimate for 2040 based on national policies. They cover both capacity and price activation aspects. With the strong development of other technologies (e.g., batteries with EV and electrolysis-based hydrogen), the scenarios show limited use of regular DSM. Nevertheless, flexible use of electrolyser enables by H2 short- or long-term storage, can be considered as DSM. In such case there is a large DSM development in the scenarios.
The difference related to synthetic methane between ENTSOs & EC scenarios are significant. This deserves a specific explanation (impact on system costs as well)	TYNDP scenarios expect that a direct use of hydrogen will be more common than the transformation of hydrogen to synthetic methane. TYNDP scenarios thus have less synthetic methane than EC scenarios.
With regards to the C budget overshoot, have any calculations been made for negative emissions technology? Costs, years required (post 2050) to reach C budget	The report provides a quantitative evaluation of the overshoot in 2050 (page 41 of the report: 10.2 Gt in GA and 18.6 Gt in DE). Taking into account the highly political aspect of carbon removal, scenarios are not investigating the topic beyond the Executive Summary highlighting the need of such technologies.
Are there any plans to run a scenario which does not exhaust the carbon budget before 2050?	No, three scenarios are considered for the TYNDP 2022. • National Trends: reflects the most recent EU MS's national energy and climate policies and strategies • Distributed Energy: higher European autonomy with renewable and decentralized focus • Global Ambition: global economy with centralized low carbon and RES options
In relation to asset valuations, is there any consensus or central set of assumptions re: discount rates (according to types and locations of energy assets)?	One discount rate has been used for all investment candidates (independently of the technology and location). The value is 6% for all scenarios across the time horizon.