Q&A on the System Needs methodology

Based on discussions held at the online workshop on the identification of future energy system needs in TYNDP 2022 - Methodology, key assumptions and outputs (14 October 2021)

Contents

General questions about the methodology

How does the IoSN study relate to the cost-benefit analysis of projects?

The assessment of system needs and the cost-benefit analysis of projects are two distinct steps in the TYNDP process, that complete each other to help policy-makers identify the most relevant projects at a given time.

The System Needs study looks at where the flow of electricity could be improved across Europe, to reach decarbonisation targets and keep security and costs under control. It does not look into solutions to address the identified needs, but only at where action is needed. Identified needs can be addressed by any solution, including non-wire solutions.

Identifying solutions to the needs is up to project promoters, who may propose their projects for assessment in the TYNDP. ENTSO-E looks at how individual projects perform on a series of indicators. When selecting European Projects of Common Interest, policymakers consider both projects' cost-benefit analysis results and whether the project addresses a need identified in the System Needs study.

How will TYNDP 2022 IoSN study improve the analysis of power system flexibility?

For the first time in the System Needs study of TYNDP 2022 ENTSO-E will include flexibility solutions in its analysis. Concretely, this is done by proposing to the optimiser storage and peaking units (with a set capacity and cost) in each country, together with cross-border transmission capacity increases solutions. Flexibility and capacity increases solutions will complete each other, and it is expected that the optimum identified by the optimiser will include both flexibility and capacity increases needs.

In the zonal model, how are the zones defined for each country?

"All models are wrong, some models are useful". There is no perfect zonal model. The perfect clustering would have one node per zone, which is not realistic. It is therefore necessary to cluster zones together to form one node.

In the previous TYNDP, the zonal clustering was based on administrative boundaries, which led to suboptimal results in some countries.

In TYNDP 2022 the zonal clustering seeks to represent grid contingencies. It represents a compromise between the level of detail (the more zones within a country, the more accurate the model) and the total number of zones (the more zones there are, the more difficult it is to run the model). Several criteria were considered, including which lines to put on equivalent links, the limiting elements, the number of zones so that the model converges, the capacities obtained after clustering…

Can the IoSN methodology capture the full benefits of connecting EU to non-EU countries?

The zone covered by ENTSO-E extends beyond the EU. The Balkans are covered in the IoSN study, and the list of capacity increases proposed to the optimizer includes all existing projects EU to non-EU countries provided they have PCI status. These investment candidates from EU to non EU countries are included in the study just like internal EU projects.

ENTSO-E has a workstream with MedTSO to improve the modelling of North African countries in our studies.

What if an investment candidate is selected by the optimiser in 2030 and not in 2040?

It is normal that when looking at two different scenarios two different optimal configurations are identified. The list of needs identified by the IoSN study is just one example of an optimal configuration and changing the scenario or the investment candidates would likely bring different optimal configurations. The value of the IoSN study is not to find THE optimal solution, but to show that there are margins for improvement.

The situation where investment candidates were part of the optimal solution in 2030 but no in 2040 happened in TYNDP 2020 on two borders, where the investment candidates did not have enough benefits compared to their costs to be selected in 2040. Deeper analysis revealed that these needs were selected in an 'upperbound' solution: the optimum was very flat and, when broadening it to include needs that delivered just slightly lower overall benefits, these investments were included. This 'upperbound' solutions can be found in Figures 1.4 and 1.5 of the IoSN 2020 report. This shows that these investment were still valuable in 2040.

Do you intend to implement flow-based market coupling into your model in future?

There is no such plan at the moment, because we do not know how to do it or even if it is doable. The System Needs study in the 2030 horizon uses a zonal model, which is another way to consider grid constraints into a market study.

Will the 70% rule of the Clean Energy Package be taken into account into the study?

The 2022 edition of the System Needs study does not take into account the 70% rule, because ENTSO-E considers that for now there is not sufficient maturity or alignment of views on how to implement this rule in our models. There are workstreams ongoing with regulators and other actors, but no consensus has emerged so far.

How to evaluate the benefits of each investment if they are all proposed simultaneously in a co-optimisation?

The benefits of specific investments are assessed in a second step, the cost-benefit analysis of individual projects, which is separate from the assessment of system needs. To know the impact of one single element in the system, interested stakeholders should turn to the TYNDP project sheets where ENTSO-E publishes results for a series of indicators, from the impact of a project in terms of increased socio-economic welfare, CO2 emissions reduction, …

The system needs study does not look at the specific impact of each element. Instead, it seeks to prove that there exist a world in which investing in the energy system will deliver benefits. By doing so, it points to where are the most likely areas to get these benefits. The system needs study is not an assessment of transmission or flexibility solutions. Identified needs can be addressed by any solution, including non-wire solutions.

Will you publish the methodology employed to choose climate years?

It is a public methodology, used in the bidding zone study.

How does ENTSO-E select the time horizons investigated by the study? 2030 is too short term, ENTSO-E should look at the longer term.

ENTSO-E understands there is an interest in the 2050 time horizon, among project promoters, industry, policymakers and investors.

The System Needs study looks at 2030, because it is the time horizon currently being investigated in the PCI process run by the European Commission, which the TYNDP feeds into.

ENTSO-E has considered the possibility of studying time horizons beyond 2040. The farther away into the future, the more uncertain the models would become. The level of uncertainty which we would face for 2050 and beyond renders this study too expensive in terms of work to have a proper representation of 2050.

How is the list of investment candidates developed?

Regarding cross-border capacity increases, ENTSO-E collected data (capacity and costs) from project promoters of TYNDP 2020 projects in the fall of 2021. On borders where there were no or few existing planned investments, the collected data was completed by conceptual projects proposed by TSOs. The ultimate objective being to propose to the optimiser a list of investment candidates with realistic capacities and costs.

Cost assumptions include the CAPEX of the investment and the cost of any needed reinforcement of the internal transmission network.

As regards flexibility investments, the assumptions are based on data collected and consulted with TSOs within the scenario building process. It is not broken down into distinct investments but takes the form of capacity in MW per market with associated costs.

Does the TYNDP System Needs study look at inertia?

Inertia is assessed in a separate study, which will be released together with the System Needs study. The last edition of this study is available here.

How is the kalte Dunkelflaute taken into account?

This is taken into account by using multiple climate years chosen on a statistical basis in order to represent all types of years, including very cold years with low wind.

How does ENTSO-E intend to capture the offshore benefits in future studies?

In the TYNDP 2020 System needs study, the wind and solar capacities were part of the scenarios, meaning that connection costs are treated as an externality, which in the case of offshore wind may represent an even higher deviation from overall system costs optimality. The study does not focus on the optimal connection of (all types of) generation. For that reason, so called 'hybrid projects', i. e. the combination of interconnections and offshore generation units, were not identified.

ENTSO-E is currently developing a methodology to capture the benefits of offshore hybrid infrastructure. While some methodological elements and early results may be released with the 2022 Needs study, this new methodology will most probably be implemented only in TYNDP 2024.

How does the model take into account the difficulty to build infrastructure?

The costs of the investment candidates consider all factors. For capacity increases, candidates located on borders where the topology makes it difficult to build infrastructure will have costs that reflect that reality. As a result, it will be more difficult for these projects to be selected by the model.

How does the study deal with the opportunities of sector coupling / system integration?

This is taken into account in the scenario, via Power-to-Gas and vehicle-to-grid. For scenarios data please refer to the TYNDP 2022 scenarios data visualization platform.

Will the System Needs study assess the impact of more interconnection on generators profitability?

The System Needs study looks at benefits for the entire European society, not at benefits for individual actors.

Will it be possible to submit projects to the TYNDP 2022 after the release of the System Needs study 2022?

No, it will not. In TYNDP 2020 ENTSO-E organized a second submission window after the release of the system needs study, reserved to future projects (post 2035) addressing needs identified in the study. The lessons learned from this exercise is that, while it allowed to identify a few projects, it tends to create confusion for project promoters. In addition, the System Needs study being released every two years, ENTSO-E considers that promoters can identify projects and submit them to the next TYNDP (for example, develop a project for submission in TYNDP 2024 based on results of the 2022 System Needs study).

About scenarios

On which scenario(s) will the TYNDP 2022 system needs study be performed?

The 2022 System Needs study will be based only on the *National Trends* scenario.

Unlike *National Trends* which is a scenario made on TSO data, *Distributed Energy* and *Global Ambition* are designed to meet the objective of climate neutrality in 2050. To build them, we run optimization engines that model the scenarios based on this objective. Therefore DE & GA can in a way be seen as system needs. This is the main reason why the IoSN study is performed only on National Trends.

In the reports accompanying the release of the IoSN study we foresee to look at how the identified system needs compare to the capacity increases part of scenarios DE and GA.

Is the reference scenario of the System Needs study the same scenario as for the cost-benefit analysis of projects?

The *National Trends* scenario will be used both for the System Needs study and to perform the cost-benefit analysis of projects, in both 2030 and 2040. The cost-benefit analysis is also planned to be performed on two other scenarios, *Distributed Energy* and *Global Ambition*.

The NT scenario will quickly become redundant as EU member states increase their climate ambition. Should the System Needs study be repeated for more ambitious scenarios?

As countries increase their ambition, the *National Trends* scenario in each successive TYNDP becomes more ambitious in turn. The NT scenario that will be assessed in the system needs study of TYNDP 2022 is more

ambitious than the same scenario assessed in the system needs study of TYNDP 2020. We expect that the same study if repeated in TYNDP 2024 will look at a more ambitious scenario still.

About the availability of data and models

Will all the data used to perform the study be made available, such as RES and hydro time series?

All main datasets will be published. Because of the mass of data, we do not systematically publish everything but stakeholders are welcome to contact us in case they are interested in obtaining data that is not published on our website.

It can happen that we cannot release data, because either:

- It is private data that we paid for, such as climate data;
- The regulation prevents us from releasing some data, such as network models.

The list of investment candidates including capacities and costs assumptions will of course be published.

Will the zonal clustered model be published in open data format to allow complementary research work?

Yes it will. The clustering used in TYNDP 2020 is already published, the TYNDP 2022 zonal clustering will be released together with the study in Q3 2022.

Annex - Questions and comments received during the webinar

How do you intend to capture the offshore benefits in future studies?
Are there any constraints applied to the model? e.g. taking into account maximum build rates of infrastructure
I hope you learn from the fast-deteriorating British grid: https://www.storelectric.com/where-grid-regulation-went-wrong/
What will be the Reference Scenario? Specifically, will it be the same with the rest of TYNDP exercise or not?
Will the second window for providing the projects In TYNDP process opened after the IoSN study?
Regulations make the best project impossible, e.g. connecting large renewables to grids through large-scale long-duration inertial storage: contracts impossible
How the flexibility of the power system analysis In the IoSN study will be improved?
The timeline shows the CBA assessment starting in Q1 2022, so before the end of IoSN. What is the expected impact of IoSN process on the CBA assessment ?
Is there any News on the Issue of Inertia ?
How do you deal with the opportunities of system integration/ sector coupling in the study?
What are the parameters being tested, amps only or voltage, frequency, etc as well?
What can ENTSO-E do about regulations which, throughout Europe, make new large-scale long-duration inertial storage impossible to fund/contract?
Will there be an option to de-select receiving a CBA for a project like it was possible last time for projects under construction?
On the time slide, are dates on the top supposed to be 2022?
A cost is required to see if the need is justified is this based on only lines or are stations, cables, PFC, being used to define if a need is justified.
What will be the improvement in the IoSN methodology to capture the full benefits for a connection between European country and non-European. (Tunisia-Italy)
System needs definition omits stability (based on real inertia, not synthetic) and skates over worst-case scenarios like kalte Dunkelflaute.
Inadequate calculation of trade-offs, e.g. need to triple grid sizes for renewables UNLESS sufficient well-located large-scale long-duration inertial storage.
Do you intend to implement flow-based market coupling into your model in the future?
How do you choose the zones for each country?
Planning grid needs must not only be statistical but also (separately) designed for worst-case, e.g. kalte Dunkelflaute when nearly all countries import by 2040
How to evaluate the benefits of each investment (of one interconnection for example) if they are all doing at the same time with a co-optimization ?
2030 is too short-term: grid-connected projects often take this long just to be financed, planned and built. Must focus on longer-term: 30+ years.
Is the flexibility of all storage and pump storage power plants considered?

In your modelling, don't ignore the simple yet powerful way of calculating the need for storage: https://www.storelectric.com/calculating-the-need-for-storage/
Smart technologies can increase transmission capacity, and can be deployed faster than new-build transmission. How do studies take their benefits into account?
Why only hydro pump and battery storage is considered? What about thermal storage with synchronous machines that can provide inertia in both operation modes?
Is it planned to use projected 2040 climate years ? which could be significantly different given climate change at such time horizons
Are the climate years now probabilistic or still based on hostoric data?
To what degree do you seek to get National Regulatory Authority 'buy in' to your methodology such that this significant piece of work is accepted by NRAs?
Will you assess the impact of more interconnections on generators profitability?
We would like both Swiss zones to be merged, how should we proceed?
Flexibility isn't just storage and generation. Smart transmission tech is also essential. How taken into account?
Why the inertia of the demand is not considered?if the storage has synchronous machines can contribute in the grid inertia support also in charge mode.
Hybrid offshore networks will show value, but fail in times of system stress. See https://www.storelectric.com/offshore-energy-networks/
For next steps is possible to review the current capacity threshold 225MW for PCIs? In order to allow to access different storage technologies
ENTSO-E: "we are not the body setting the agenda nor leading the review of Regulations". Regulations prevent the solutions the grids need, so are 100% relevant.
How is PFC used in market zonal and NTC modelling?
How is the investment candidate list developed and set?
Flexibility of Sorage (Pump Hydro and Batteries): Is the long term flexibility taken into account (dayly, weekly and longer...)?
How would isolated systems be treated in the model? And how do assign value in lifting the energy isolation of a country
Why is flexibility only for peaking and storage, where are other sources considered as EC requirement to maximise existing grid first
What if one given interconnection candidate is selected by the optimizer in 2030 but not in 2040 ?
Will the 70% rule of the Clean Energy Package will be taken into account in determining maximum cross-border exchanges?
Will the IoSN for 2022 TYNDP take into account all three scenarios? (NT, DE and GA) If so, will we see three different optimised power systems configurations?
National Trends scenario will quickly become redundant as countries increase climate ambition. Should the analysis be repeated for more ambitious scenarios?
Will you publish the methodology how climate years are chosen?
Are you also going to use the NTC model (as well as the zonal model) for 2030 to assess the imapct of different weather years?

The answer to Zeid's questions was not clear. If the Italy- Tunisa project is not a PCI, is it ignored from the IoSN calculation?
Do you consider SSSCs for digital power flow control, as part of the flexibility solutions?
in TYNDP2018 Tunisia was endogenous zone, but this was not kept in TYNDP2020. Tunisia but also Algeria and Morocco should be endogenous in 2030-2040 studies
Ukraine and Moldova should be also put in 2030 and 2040 picture as endogenous zones, considering the synchronisation pattern
Why 70% rule on cross-zonal capacity will not be taken into account? Identified system needs may be overestimated then.
It could be important that ENTSO-E publishes all the data, including costs for candidates used for the planning option application of ANTARES
Will the zonal clustered model will be published in opendata to allow complementary research works ?
I disagree 2050 too difficult. 2050 is what we need to do to decarbonise. 2030 (just 8 years) is an extrapolation of current plans. Totally different approach.
RES and Hydro time series have a great impact on this study. Will you consult them? 2040 RES time series were not published nor consulted in the previous IoSN
The market analysis is Performer only SEW based? Why?
How ist the Location of possible flex solutions identified?
Will future models consider the impact of rising temperatures on line capacity? More capacity may be needed just to overcome this limitation.
Thank you so much for this very meaningful interactive webinar. Well done! 👏👏👏
No-regret decisions can only be taken in the context of 2050 plans/scenarios (not 2040), otherwise "solutions" may become obsolete by decarbonisation.
All data and methodologies should be consulted to the general public to ensure fair treatment (e.g towards storage) improve transparency and avoid arbitrariness