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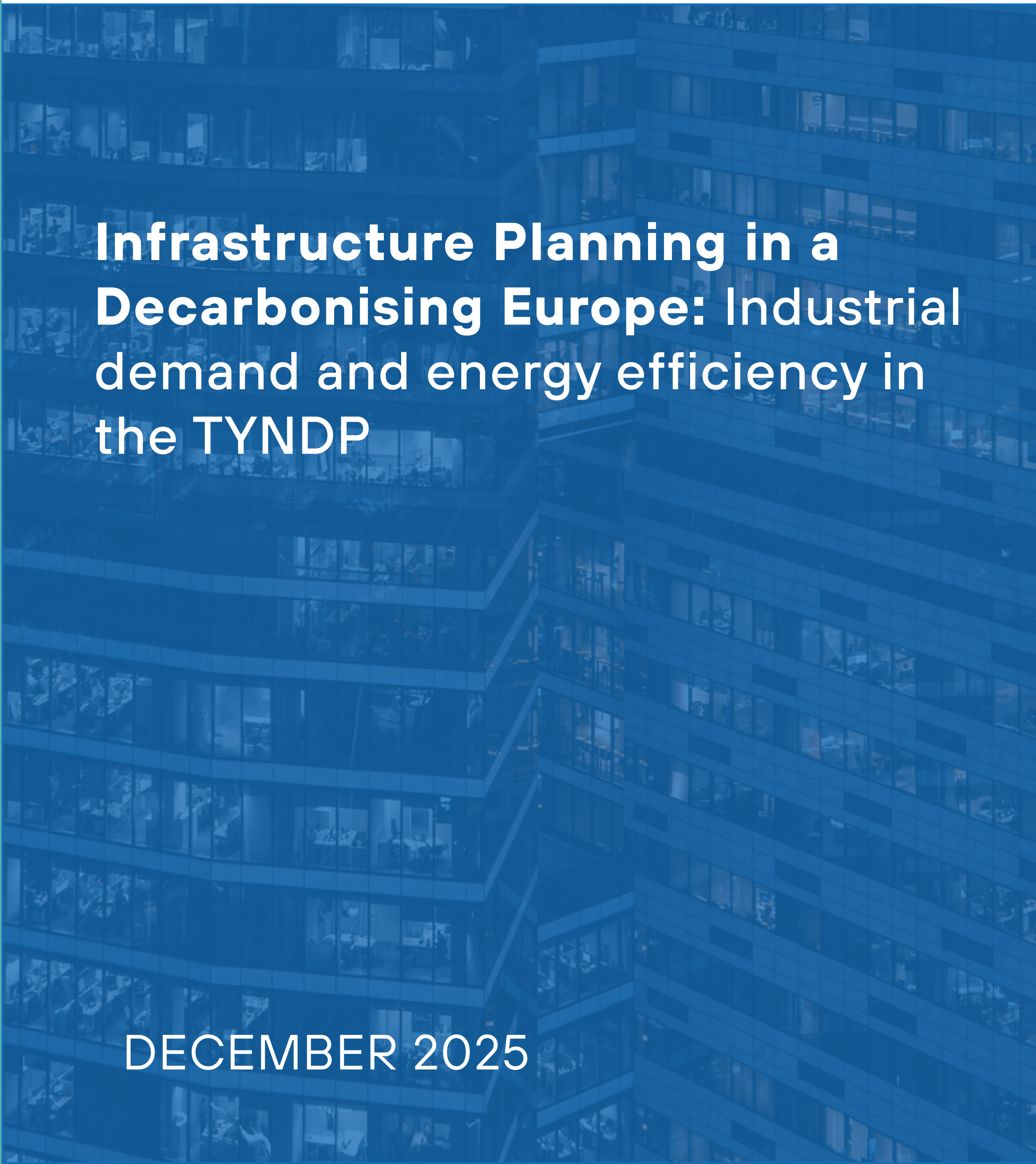

Infrastructure Planning in a Decarbonising Europe: Industrial demand and energy efficiency in the TYNDP

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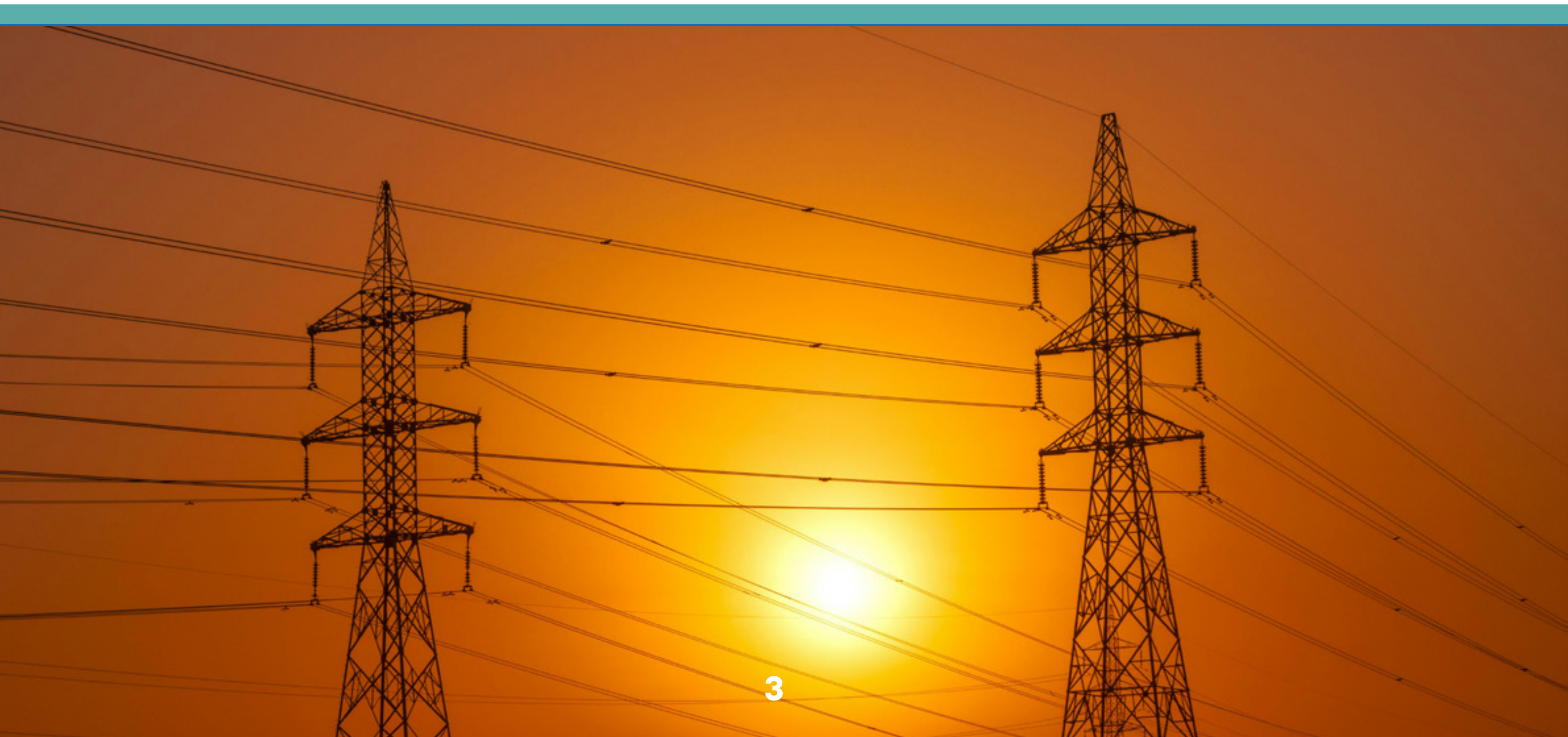
Table of Contents

1. Current Status of EU Energy Infrastructure & Planning **4**
2. Governance **5**
2.1 How EU Planning is Organised 5
3. Industrial Demand **8**
3.1 Background 8
3.2 How Industrial Demand is Currently Modelled 9
3.3 Issues 11
4. Energy Efficiency **12**
4.1 Background 12
4.2 How Energy Efficiency is Currently Included in Planning 12
4.3 Issues 14
5. Policy Recommendations and Conclusions **15**



1. Current Status of EU Energy Infrastructure Planning

Energy systems rely on long-lived, capital-intensive infrastructure. Once built, networks are largely fixed in location for decades. Making the right planning decisions is therefore central to delivering a decarbonised, secure and affordable energy system, and to avoiding stranded assets and lock-in to high-carbon solutions.

The next ten to fifteen years will be pivotal: the EU must simultaneously decarbonise power, electrify industry, buildings and transport, integrate new hydrogen and CO_2 infrastructure, and phase out most fossil generation[1]. Infrastructure planning has the potential to enable this transition or slow it down.

Over time, the EU has developed several complementary planning processes, each with its own scope and purpose. These include Union-wide network development via the Ten-Year Network Development Plan (TYNDP), national transmission and distribution development plans, adequacy assessments such as the European Resource Adequacy Assessment (ERAA) and National Resource Adequacy Assessments (NRAAs), as well as newer exercises such as flexibility needs assessments and the selection of cross-border infrastructure as Projects of Common Interest[2],[3]. The proposals, published in the European Grids Package (2025), move this framework towards a more integrated EU planning system, including a central EU scenario and stronger coordination between national and European planning[4].

Among these instruments, the TYNDP plays a particularly central role. Prepared every two years by ENTSO-E, it provides a pan-European view of future system needs and serves as the main analytical basis for identifying priority cross-border projects[5]. Other processes increasingly depend on its scenarios and data, including PCI/PMI selection and, through consistency requirements, national adequacy and flexibility assessments. In practice, the TYNDP acts as a reference point for much of Europe's grid investment agenda[6,7].

This brief focuses on three tightly linked questions:

- How does the governance framework shape, enable or constrain improvements in these areas?
- How is industrial demand currently modelled and integrated into TYNDP planning?
- How is energy efficiency treated and operationalised in practice?

1 European Commission. (2020). *Powering a climate-neutral economy: An EU strategy for energy system integration* (COM(2020) 299 final). Publications Office of the European Union.
2 European Parliament & Council of the European Union. (2022). *Regulation (EU) 2022/869 of 30 June 2022 on guidelines for trans-European energy infrastructure and repealing Regulation (EU) No 347/2013* (Text with EEA relevance). Publications Office of the European Union.
3 European Parliament & Council of the European Union. (2019). *Regulation (EU) 2019/943 of 5 June 2019 on the internal market for electricity* (Text with EEA relevance). Publications Office of the European Union.
4 European Commission. (2025, December 10). *Commission proposes upgrade of the EU's energy infrastructure (European Grids Package)* (IP/25/2945).
5 European Network of Transmission System Operators for Electricity (ENTSO-E). (n.d.). *What is the TYNDP and why does Europe need a plan for electricity infrastructure?* ENTSO-E. Retrieved December 15, 2025.
6 European Union Agency for the Cooperation of Energy Regulators. (2024). *Electricity infrastructure development to support a competitive and sustainable energy system: 2024 monitoring report.* ACER.
7 European Union Agency for the Cooperation of Energy Regulators. (2025, September 19). *ACER proposes improvements to the European grids legal framework.* ACER.

2. Governance

2.1 How EU Planning is Organised

EU electricity-infrastructure planning is built on a detailed governance framework. The Electricity Regulation (2019)[8] and Directive (2019)[9], the TEN-E Regulation (2022)[10], and the Governance Regulation (2018)[11] together define who plans what, on which data and with which constraints. At the centre of this framework sits the Ten-Year Network Development Plan (TYNDP), produced by ENTSO-E and ENTSOG with inputs from multiple stakeholders every two years.

While it is often used as a general reference for EU grid planning, the TYNDP is, in legal terms, an instrument primarily designed to identify pan-European and cross-border transmission infrastructure needs, rather than to plan all national networks in detail[12].

The TYNDP plays two key roles. First, it should provide a pan-European view of future system needs, identifying where capacity, flexibility or resilience may be lacking in the coming decades. Second, it acts as the entry gate for Projects of Common and Mutual Interest (PCIs/PMIs): as a rule, only projects included in the TYNDP can be considered for PCI/PMI status and related EU support[13]. This makes the TYNDP one of the most influential planning instruments in the EU energy system.

How the TYNDP process works

As of 2025, the TYNDP follows a structured sequence on a two-year cycle:

1. **Scenario development**
   The ENTSOs develop joint scenarios for the European energy system. These include projections for electricity demand, generation, hydrogen use and flexibility. Scenarios should aim to be:

   a. be consistent with EU climate and energy objectives; and

   b. take into account national projections, especially the National Energy and Climate Plans (NECPs).

   ACER issues **Scenario Framework Guidelines** that define the main rules and constraints scenario development[14].

2. **System needs assessment**
   Based on these scenarios, the ENTSOs identify future structural issues: congested corridors, cross-border bottlenecks, regional adequacy risks and flexibility gaps. The result is a map of anticipated "system needs"[15].

8 European Parliament & Council of the European Union, 2019/943.
9 European Parliament & Council of the European Union. (2019). *Directive (EU) 2019/944 of 5 June 2019 on common rules for the internal market for electricity* (Text with EEA relevance). Publications Office of the European Union.
10 European Parliament & Council of the European Union, 2022/869.
11 European Parliament & Council of the European Union. (2018). *Regulation (EU) 2018/1999 of 11 December 2018 on the governance of the energy union and climate action* (Text with EEA relevance). Publications Office of the European Union.
12 European Network of Transmission System Operators for Electricity (ENTSO-E) & European Network of Transmission System Operators for Gas (ENTSO-G). (2025). *TYNDP 2024 scenarios methodology report*. ENTSO-E & ENTSO-G.
13 European Parliament & Council of the European Union, 2022/869.
14 European Union Agency for the Cooperation of Energy Regulators (ACER). (2023). *Framework Guidelines for the joint TYNDP scenarios to be developed by ENTSO for Electricity and ENTSO for Gas - "TYNDP Scenarios Guidelines"*. ACER.
15 European Network of Transmission System Operators for Electricity (ENTSO-E). (2023). System needs report: TYNDP 2022 - *Opportunities for a more efficient European power system in 2030 and 2040*. ENTSO-E.

3. **Cost-Benefit Analysis (CBA) of projects**
   Transmission projects proposed by TSOs are assessed against a "no-project" baseline using a common CBA methodology approved at EU level. Key indicators include socio-economic welfare, market integration, security of supply, environmental impacts and resilience. The methodology does not explicitly require systematic comparison with energy efficiency or other non-wire alternatives[16, 17].

4. **Reporting and consultation**
   ENTSO-E publishes scenario documentation, the system needs report and project level CBAs as a TYNDP package. Stakeholders (including industry, civil society, consumer groups and regional authorities) are consulted through public consultations and the Stakeholder Reference Group (SRG)[18].

5. **Commission review and link to PCI/PMI**
   The European Commission reviews and approves the TYNDP. It also uses the TYNDP when selecting PCIs and PMIs.

Actors and tasks

The main actors in this governance system have distinct roles:

- **ENTSO-E** coordinates data collection from TSOs, develops scenarios, performs system needs assessments and conducts CBAs for candidate projects. It can design methodologies within limits but must base scenarios primarily on bottom-up national inputs and EU targets.
- **ENTSOG** plays a similar role with regards to gas infrastructure, and **ENNOH** for hydrogen.
- **ACER** oversees and reviews the process. It sets the Scenario Framework Guidelines, issues opinions on scenarios, needs assessments and CBA methodologies, and can highlight weaknesses or request improvements. It does not run its own modelling but acts as an independent checker.
- The **European Commission** reviews and approves the TYNDP, ensures alignment with EU legislation and climate objectives, and uses it to select PCIs/PMIs. It can ask ENTSO-E for clarifications or adjustments.
- **Member States and NRAs** provide NECPs and other national data, are consulted on scenarios and infrastructure plans, and offer regulatory and policy input. Their projections strongly condition what ENTSO-E can do in practice.
- The **European Scientific Advisory Board on Climate Change (ESABCC)** can provide independent scientific advice on the alignment of scenarios and infrastructure portfolios with EU climate targets.
- **Stakeholders**, including industry, civil society, consumer organisations and regional authorities, participate through consultations and the SRG. They can challenge assumptions, highlight missing developments (e.g. industrial clusters, flexibility options) and feed in information from the ground.

16 European Network of Transmission System Operators for Electricity (ENTSO-E). (2023, April 26). *New version of CBA 4.0 methodology for assessing electricity infrastructure projects*. ENTSO-E.
17 ACER, 2024
18 European Network of Transmission System Operators for Electricity (ENTSO-E). (2023). *Stakeholder reference group*. ENTSO-E.

2.3 Bottom-up data: strength and limitation

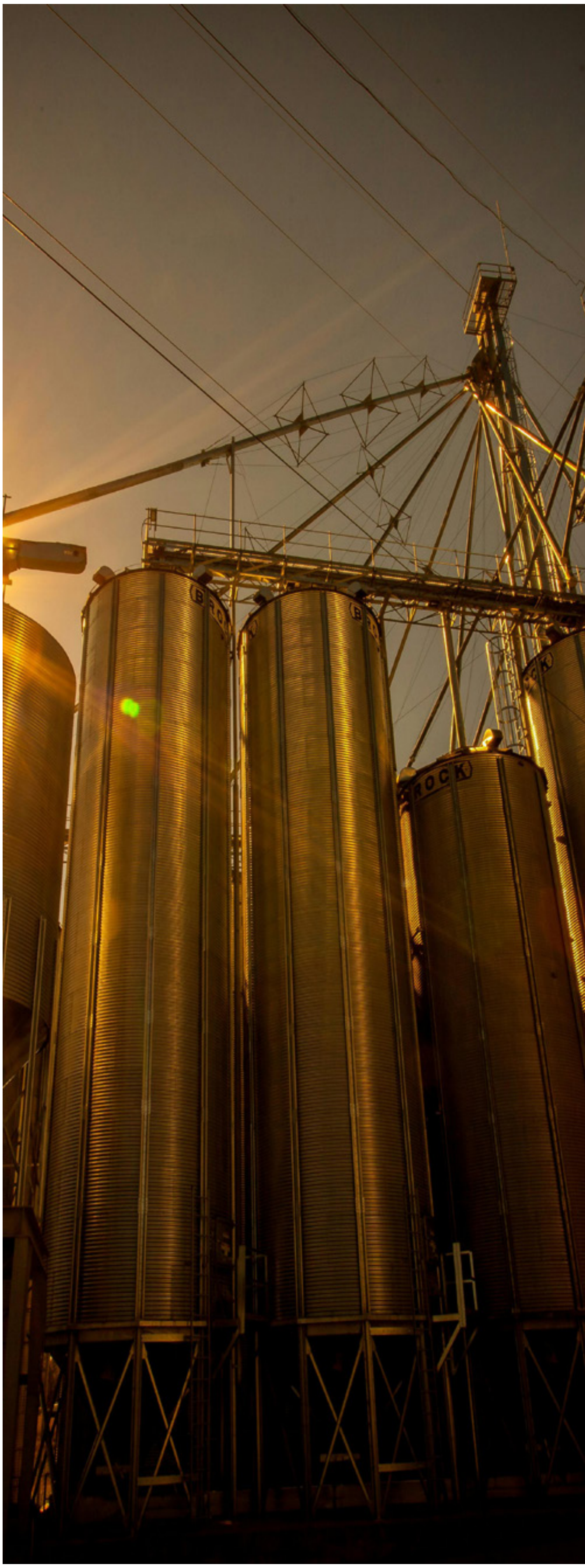
A central design feature of this governance framework is its reliance on bottom-up data. TYNDP scenarios are grounded in NECPs and TSO inputs[19]. This has clear advantages: it respects national competences, anchors scenarios in official plans and gives political legitimacy to the TYNDP.

However, it also creates structural limitations. If NECPs are incomplete or lack sectoral and spatial detail, if TSOs use divergent or opaque methods to fill data gaps, or if there is no strong EU-level mechanism to correct these weaknesses, those shortcomings propagate upward into the TYNDP .

These limitations are particularly visible in two areas that are central to this brief:

- **industrial demand**, which is often under-specified and treated as a smooth national trend despite increasingly clustered real world developments; and
- **energy efficiency**, which is embedded as an ex-ante demand assumption but rarely considered as a concrete alternative to infrastructure investment.

The proposals in the European Grids Package, tabled in December 2025, put forward a central EU scenario for TYNDPs that would sit on top of this bottom-up structure, but would still depend heavily on the quality and granularity of national inputs provided through NECPs and TSO data[20].



19 ACER, 2023
20 European Commission. (2025). Proposal for a revised Trans-European Network for Energy (TEN-E) Regulation (COM(2025) 1006 final). Chapter IV. Publications Office of the European Union.

3. Industrial Demand

3.1 Background

Europe's industrial landscape is changing rapidly as sectors modernise and decarbonise. Heavy industries that have traditionally relied on fossil fuels are shifting toward processes powered by clean electricity. Wherever electrification is technically possible (from mechanical drives to low- and medium-temperature heat) companies are moving toward electricity-based systems. In parallel, hydrogen is emerging as a complementary energy carrier, to be used in some applications where electrification cannot deliver the required technical performance[21].

This reconfiguration of industrial energy use leads to a significant and sustained increase in electricity demand, but this increase will not be uniform. The rise in demand will materialise in specific industrial zones: ports, chemicals complexes, steel corridors, manufacturing hubs, and regions that produce hydrogen or synthetic fuels from renewable electricity[22]. Across Europe, industrial policy initiatives, connection request pipelines, and large-scale investment decisions consistently show the same pattern: industrial decarbonisation will concentrate new electricity loads in specific, high-value locations, rather than produce a homogenous rise in national consumption. The recently published Commission guidance on efficient grid connections explicitly notes that policies on strengthening industrial manufacturing capacities and developing industrial hubs should feed into anticipatory grid planning, underlining the need to connect industrial-policy pipelines and network planning in a more systematic way than is currently the case [23].

This has profound implications for grid planning. Electricity networks are becoming central to industrial strategy. The availability, location, and timing of network reinforcements increasingly determine whether new industrial projects can proceed, where new plants are sited, and how fast companies can transition to cleaner processes[24]. In many countries, the electricity grid is already the decisive factor shaping industrial investment decisions.

Same applies to hydrogen infrastructure, with the added challenge of scarce supply and demand points. Recent monitoring of hydrogen Important Projects of Common European Interest (IPCEI) and the European Clean Hydrogen Alliance pipeline confirms how uneven and contingent the landscape is for hydrogen. Large hydrogen projects are heavily concentrated in a few areas (notably the Iberian Peninsula and Germany), and nearly two-thirds of IPCEI projects are not on track, mainly due to funding gaps, grid access issues and a lack of committed off-takers[25].

If the future network does not anticipate where demand will emerge, Europe risks failing to deliver key decarbonisation projects or losing industrial activity to regions with more predictable and better-prepared grid capacity.

In this context, the question of how industrial demand is modelled, and how those projections influence EU-wide grid planning, becomes critical.

21 European Commission. (2020). A hydrogen strategy for a climate-neutral Europe (COM(2020) 301 final). Publications Office of the European Union.
22 Mario Draghi. (2024). *The future of European competitiveness – Part A: A competitiveness strategy for Europe.* Publications Office of the European Union.
23 European Commission. (2025). *Guidance on efficient grid connections* (C(2025) 8473 final). Publications Office of the European Union.
24 ACER, 2024.
25 European Commission: Report on implementation and monitoring of large-scale hydrogen deployment projects: the IPCEIs on hydrogen and the ECH2A project pipeline, SWD(2025) 121 final, May 2025.

3.2 How Industrial Demand is Currently Modelled

National submissions: where industrial demand enters the process

The modelling of industrial electricity demand begins at national level. Each Member State sets out its policy expectations and sectoral pathways in the National Energy and Climate Plan (NECP). These documents include projections for industrial energy use, electrification rates, hydrogen uptake, and efficiency improvements. However, NECPs vary widely in detail: some provide granular sector by sector analyses; others only publish aggregated final-energy values with limited breakdowns[26].

Transmission System Operators (TSOs) take NECPs as the starting point for constructing national scenario datasets. They fill in missing detail, interpret national strategies, and translate policy ambitions into demand projections for the electricity system. Where NECPs lack clarity or provide top-level figures, TSOs apply their own assumptions. They also incorporate insights from grid connection requests, industrial development plans, and established consumption patterns. Because this process is national and decentralised, industrial demand is modelled differently in every Member State, even when countries face similar industrial transitions[27].

EU-level integration: harmonisation rather than re-modelling

Once national datasets are prepared, ENTSO-E and ENTSOG integrate them into EU-wide scenarios using a modelling framework that harmonises and aligns inputs from across the Union. The objective is consistency: national projections are combined into a common dataset, adjusted where necessary to match EU-level climate and energy objectives, and used to generate coherent European trajectories[28].

However, this integration is largely an aggregation exercise, not a fresh EU-wide assessment of industrial demand. Industrial load projections remain rooted in the national assumptions provided by TSOs. The European-level modelling process does not independently reassess whether industrial electrification is accelerating faster than national plans suggest, whether new industrial clusters are emerging, or whether cross-border patterns of industrial development should influence demand allocations.

Governance structure: why national assumptions dominate

The dominance of national inputs is not accidental, it is built into the governance framework. EU rules require ENTSO-E to ensure that scenarios are consistent with NECPs and other official national strategies. This ensures political legitimacy, but it also means that ENTSO-E has limited scope to adjust national industrial demand projections, even when new evidence suggests they may be outdated or incomplete.

As a result, industrial demand in the TYNDP is strongly shaped by:

- the level of detail provided in NECPs,
- the assumptions made by TSOs when interpreting those NECPs, and
- the absence of an EU-wide mechanism to check or refine those assumptions.

26 European Commission. (2025). Action Plan for Affordable Energy Unlocking the true value of our Energy Union to secure affordable, efficient and clean energy for all Europeans (C(2025) 79 final). Publications Office of the European Union.
27 European Union Agency for the Cooperation of Energy Regulators (ACER). (2025). *ACER Opinion 07/2025 on electricity national development plans.* ACER.
28 Artelys. (2025). *Study to support the development of scenarios for EU-wide infrastructure planning and adequacy assessments.* ACER.

MEMBER STATE EXAMPLES

Member States bring industrial demand estimates into grid planning in different ways. Below we outline the approaches in Spain and France.

Spain

Spain's Electricity Transmission Network Development Plan 2021–2026 (NDP) is firmly anchored in the NECP and focuses on integrating renewables, maintaining security of supply and complying with decarbonisation and interconnection targets. Industrial demand is taken into account, but mostly indirectly and in aggregated form rather than through explicit industrial cluster planning.

Industrial loads enter the process mainly through two channels. First, via national demand and sector projections in the NECP, which underpin the scenarios used in the Spanish TSO's (Red Eléctrica) technical studies. Second, via "access and connection requests" and stakeholder proposals that are submitted during the formal consultation phases of the NDP. The plan makes clear that these requests, alongside NECP assumptions and regional inputs, shape the identification and prioritisation of reinforcements.

However, there is no published dedicated methodology to anticipate future industrial demand clusters (for example, green-steel hubs or new chemicals platforms). Industrial developments appear in planning documents mainly as part of structural reinforcements or as individual connection projects once they are sufficiently mature.

Overall, Spain's approach can be described as NECP and connection driven. The framework is robust for integrating renewables and assessing projects on a cost–benefit basis, but it is relatively reactive with respect to industrial demand: the grid plan largely follows where industrial projects show up in the queue, rather than proactively mapping and planning for future clusters.

France

France's Schéma Décennal de Développement du Réseau (SDDR) adopts a more explicitly industrial strategy driven approach to transmission planning. In the executive summary, RTE highlights major modifications to the very high voltage backbone by 2030, with a particular focus on major industrial port areas and central France, and directly links these reinforcements to decarbonisation and reindustrialisation objectives.

Industrial demand is treated not only as a background input, but as a key driver of where and how the grid must evolve. The SDDR explicitly identifies priority zones where large new loads are expected: industrial port complexes, strategic manufacturing regions and areas targeted for hydrogen and other low-carbon industrial projects. These zones are associated with specific reinforcements of the 400 kV network and with new substations or corridors.

The SDDR also introduces a "grid offer" mechanism for large industrial and digital users. This involves signalling which grid nodes can accommodate significant new demand, and offering accelerated full-power connections in certain zones, conditional on coordinated reinforcement of the backbone.

In short, France uses the transmission plan as a tool to enable and steer industrial electrification and reindustrialisation. Industrial demand is spatially explicit, linked to national industrial policy and reflected in the definition of priority grid zones. Compared to Spain, planning seems significantly more anticipatory, with industrial strategy and grid development more tightly aligned.

3.3 Issues

The way future industrial energy demand is currently incorporated into the TYNDP has several limitations that lead to structural issues:

National dependency leads to inconsistent industrial demand inputs

Because industrial demand is inherited from NECPs and interpreted by TSOs, the quality of inputs varies across the EU. Some Member States provide detailed industrial trajectories; others provide limited details. This creates inconsistencies that are carried forward into European planning. So far, the EU has lacked a strong, operational mechanism to harmonise these assumptions or to evaluate whether national projections are realistic in a systematic way, although the Grids Package now proposes stronger common scenarios and oversight.

Industrial geography is not well represented

Industrial electricity demand is concentrated in specific areas such as ports, logistics hubs, chemicals clusters, and future hydrogen valleys. Yet current modelling does not systematically represent these clusters. As a result, the grid planning process struggles to anticipate where large new loads will materialise.

Timing mismatch between industrial investment and the planning cycle

Industrial transformation is fast-moving. New industrial decarbonisation projects that will drive electricity and, to some extent, hydrogen demand are being announced and delivered within a few years, often moving faster than the five-year NECP cycle. Because ENTSO-E has limited room to independently update industrial demand assumptions between cycles, emerging needs frequently appear too late, if at all, in the grid-planning process, so scenarios often reflect expectations that are already out of date and cannot support timely investment decisions.

Lack of cross-border coordination for industrial corridors

Industrial activity rarely aligns neatly with national boundaries. Steel corridors, petrochemical chains, ports with shared value chains, and cross-border hydrogen clusters require regional rather than national planning. Today, such patterns are not systematically captured. TSOs submit separate national projections, and there is no mechanism for constructing a genuinely regional industrial demand picture.

TYNDP cannot fully act as a forward-looking early-warning tool

Because industrial demand is treated as an input provided by Member States, TYNDP scenarios cannot proactively identify future industrial bottlenecks or stress points. This limits the ability of the EU's main grid planning tool to anticipate where network capacity will be required to support industrial decarbonisation or re-industrialisation.

4. Energy Efficiency

4.1 Background

Energy efficiency is an essential pillar of European energy policy. The Energy Efficiency Directive (2023) sets a binding 2030 EU target to reduce primary and final energy consumption (equivalent to an additional 11.7% cut compared with the 2020 reference scenario) with explicit expectations that infrastructure planning is consistent with these goals. It also establishes the energy efficiency first principle (EE1st) as a fundamental rule, requiring that planning and major investment decisions, including on energy infrastructure, systematically assess cost-effective efficiency solutions[29].

The Energy Efficiency First principle is the governance tool intended to deliver this in practice. It is defined in the Governance Regulation (2018) as taking "utmost account" in energy planning, and in policy and investment decisions, of alternative cost-efficient energy-efficiency measures to make energy demand and energy supply more efficient, in particular through end-use savings, demand response and more efficient conversion, transmission and distribution, while still meeting the underlying objectives[30].

To operationalise the principle, the Commission adopted Recommendation (EU) 2021/1749 "Energy Efficiency First: from principles to practice"[31]. This non-binding act translates EE1st into expectations for authorities, regulators and system operators. It calls them to apply EE1st in policy, planning and investment decisions across sectors; develop cost-benefit methodologies that systematically compare demand-side and efficiency options with supply-side and network investments; and ensure that relevant entities (such as NRAs and permitting authorities) verify the application of EE1st when they approve or monitor projects and plans[32].

Together, the EED (2023), the Governance Regulation (2018), the Energy System Integration Strategy (2020)[33] and the Recommendation (2021) create a clear expectation that infrastructure planning, including the TYNDP, should treat efficiency and demand-side resources as first-order options, not afterthoughts.

In the EU's official planning hierarchy, efficiency should guide infrastructure decisions, with the aim to reduce system costs, improve security of supply, mitigate price volatility, and support industrial competitiveness. Yet, despite this formal status, energy efficiency remains only weakly integrated into electricity-infrastructure planning, both at national level and within the TYNDP.

29 Art. 3, Art. 4. European Parliament & Council of the European Union. (2023). *Directive (EU) 2023/1791 of 13 September 2023 on energy efficiency and amending Regulation (EU) 2023/955 (recast)* (Text with EEA relevance). Publications Office of the European Union.
30 Art. 2(18), European Parliament & Council of the European Union, 2018/1999
31 European Commission. (2021). Commission Recommendation (EU) 2021/1749 of 28 September 2021 on energy efficiency first: From principles to practice - Guidelines and examples for its implementation in decision-making in the energy sector and beyond (Text with EEA relevance). Publications Office of the European Union.
32 European Commission, 2021
33 European Commission. (2020). *Powering a climate-neutral economy: An EU strategy for energy system integration* (COM(2020) 299 final). Publications Office of the European Union.

4.2 How Energy Efficiency is Currently Included in Planning

As described in the governance section, NECPs are the starting point for both national and EU-wide scenarios. For energy efficiency, this means that whatever Member States quantify (or fail to quantify) on renovation, industrial process improvements and efficiency more generally becomes the baseline for planning. The Commission's 2025 assessment shows that many updated NECPs still lack detailed, numerical efficiency pathways for buildings, services and industry, which limits how precisely demand reductions can be reflected[34].

TSOs then build on these NECPs in their national network development plans. Where efficiency data is weak or missing, they fill gaps with their own assumptions. ACER's Scenario Development Study (2025) notes that these assumptions vary significantly and are often not well documented, so implied efficiency trends differ from country to country. This heterogeneity is then carried into the TYNDP[35].

At EU level, ENTSO-E captures energy efficiency in TYNDP scenarios mainly through the Energy Transition Model (ETM) and other tools that apply structural improvements to industrial processes, buildings energy performance, transport efficiency, and appliance standards. However, energy efficiency is treated as a fixed assumption entered into the final demand projection before network modelling begins.

Once those demand projections are set, efficiency is no longer treated as a decision variable or a planning option in the parts of the process that identify system needs and assess specific projects. In the TYNDP Cost–Benefit Analysis (2024)[36], projects are typically compared against a "no-project" baseline. ACER's Monitoring Report on Electricity Infrastructure (2024)[37] notes that grid reinforcements are almost never assessed against non-wire alternatives, including efficiency and demand-side measures: reinforcement is effectively compared only with "do nothing", not with "targeted efficiency plus improved operation". This difference between treating efficiency as a fixed assumption and treating it as a planning option is the core gap between EE1st as a legal and strategic principle and its application in infrastructure planning.

34 European Climate, Infrastructure and Environment Executive Agency. (2025). *EU-wide assessment of the final updated national energy and climate plans Delivering the Union's 2030 energy and climate objectives.* COM(2025) 274 final. Publications Office of the European Union.
35 Artelys, 2025
36 European Network of Transmission System Operators for Electricity (ENTSO-E). (2024). *Guideline for cost–benefit analysis of grid development projects 4.0.* ENTSO-E.
37 ACER, 2024

ENERGY EFFICIENCY AND CONGESTION IN MEMBER STATES

In Spain's transmission development plan, congestion and renewable curtailment are acknowledged and used to motivate new reinforcements, and the TSO does look at congested areas when shaping investment proposals. However, this analysis is not systematically translated into criteria that would compare grid expansion with targeted efficiency or demand-side measures in the same zones. Congestion is a reason to build, not something that necessarily triggers a test non-wire alternatives[38].

In France's SDDR, congestion and saturation are mapped more explicitly: the plan identifies heavily loaded corridors and major industrial or port areas where the "backbone" must be reinforced. Yet the response remains almost entirely reinforcement-first. There is no structured step where efficiency or EE1st is considered as an alternative way of relieving congestion in those areas, for example through process-efficiency improvements in industrial clusters, accelerated renovation in constrained urban nodes, or local flexibility services[39].

Together, these examples indicate that EE1st remains largely theoretical in grid planning: efficiency is recognised in legislation and upstream scenarios, but operational data on congestion and curtailment are still not used to systematically test whether targeted demand-side action could partly or fully avoid new reinforcements, or reduce their scale.

4.3 Issues

The way energy efficiency is handled today creates several structural problems for planning.

First, efficiency is absent from the actual choice stage. It is built into demand scenarios, but when planners decide how to solve a constraint, they almost never ask whether targeted demand reduction or demand-side management could avoid or shrink the reinforcement.

Second, efficiency is not treated spatially. The most meaningful opportunities are local (industrial clusters, ports, dense urban areas, rapidly electrifying regions) but planning largely works with national or sectoral averages. This hides places where deep renovation, process upgrades or local flexibility could significantly reduce peak flows and relieve congestion.

Third, operational inefficiencies like congestion, redispatch and renewable curtailment are not framed as an efficiency problem. They are clear signs that existing grids and clean generation are used sub-optimally, yet the default response is "build more grid", not "first test demand-side options in those nodes".

38 REE, 2025
39 RTE, 2025

Planning often treats hydrogen as given, without fully accounting for the efficiency losses along its value chain or comparing them to direct electrification and demand reduction. As a result, electricity grids, hydrogen networks and storage are dimensioned for high-hydrogen futures that may be not least-cost once whole-system efficiency and no-regret electrification options are properly accounted for.

All these issues could lead to overbuild networks, higher costs passed on through tariffs, unrealised efficiency gains, and lower social acceptance when new lines appear before cheaper, less intrusive options have been seriously considered.

5. Policy Recommendations and Conclusion

The TYNDP is primarily an interconnection-focused planning tool. Nevertheless, in practice its scenarios and system needs assessment are used far more broadly to guide national grid development, select PCIs/PMIs, frame hydrogen and industrial strategies, and increasingly inform national flexibility and adequacy assessments. The European Grids Package and the proposed legislative revisions explicitly acknowledge these wider implications. They introduce an EU-wide central scenario for grids, new guidance on efficient grid connections and anticipatory planning, and stronger links between national and EU processes.

These are important steps, but they will only deliver if they are translated into concrete processes that make industrial demand and energy efficiency visible, verifiable and actionable within TYNDP and national planning. Based on the analysis in this policy paper, some priorities stand out:

MAKE THE NEW EU CENTRAL SCENARIO WORK FOR INDUSTRIAL DEMAND AND EFFICIENCY

The central EU scenario should be more than an aggregated NECP compilation. Its methodology should be public and explicitly require: (i) transparency around how national industrial demand and efficiency assumptions are translated and, where necessary, adjusted; (ii) a clear spatial representation of industrial clusters and electrification hotspots; and (iii) alignment with climate targets.

CLARIFY AND PROTECT THE TYNDP’S ROLE IN THE PLANNING FRAMEWORK

The TYNDP should remain focused on cross-border and system critical needs, but its use as a de facto reference for national and industrial planning must be acknowledged. To avoid misinterpretations, its limits should be made explicit. In other words, a clear distinction should be drawn between what is inherited from NECPs/TSOs and what is actively

4 modelled at EU level, and explicit warnings where data gaps or inconsistencies affect the robustness of its results.

PUT INDUSTRIAL DEMAND CLUSTERS AT THE CENTRE OF PLANNING

The European Grids Package and connection guidance already point to industrial hubs,
large new loads and regional planning as priorities. Building on this, TYNDP scenarios and
system needs assessments should include a dedicated treatment of industrial demand
clusters: ports, chemicals corridors, steel valleys, gigafactories and hydrogen valleys. At
national level, TSOs and DSOs should be required to map current and prospective clus-
5 ters using NECPs, industrial strategies, structured dialogue with industrial actors and
regions and grid connection pipelines. At EU level, ENTSO-E should identify cross-border
“industrial corridors” and test whether planned capacity is sufficient.

IMPROVE DATA AND TRANSPARENCY ON INDUSTRIAL DEMAND ASSUMPTIONS

The Grids Package rightly calls for better, more consistent information flows between national plans and EU-level modelling. Building on this, one priority should be to ensure that industrial demand assumptions are publicly available and reviewable, rather than to prescribe one “perfect” dataset. NECPs, national development plans and TYNDP inputs should clearly indicate what is taken from official national sources, what is inferred by TSOs, and what is adjusted at EU level in the central scenario.

OPERATIONALISE ENERGY EFFICIENCY FIRST IN GRID AND INDUSTRIAL PLANNING

While the European Grids Package reiterates the need to maximise use of existing infrastructure, current practice still treats efficiency as a fixed assumption, not a planning option. TYNDPs and national CBAs should therefore be updated so that, for major corridors and industrial regions, planners routinely test whether targeted efficiency measures, local flexibility and grid-enhancing technologies could defer or resize reinforcements. Hydrogen and other converted carriers should be assessed against direct electrification and efficiency on a whole system basis, to avoid over dimensioning of infrastructure, stranded assets, and higher system costs.

If implemented together, these recommendations would help align the TYNDP process with the ambitions of the Grids Package: using a more coherent EU planning framework not just to build more infrastructure, but to build the right infrastructure in the right places, at the right time, and at least cost. Making industrial demand clusters and energy efficiency visible in TYNDP planning is not a technical detail, it is central to whether Europe can decarbonise, remain competitive and maintain public support for the grid buildout that will still be needed.

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