WORKING PAPER

ELECTRICITY GRID CHALLENGES. WHY INSTITUTIONAL MISMATCH DELAYS EUROPE'S GRID TRANSFORMATION

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Electricity Grid Challenges. Why Institutional Mismatch Delays Europe's Grid Transformation

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Abstract

Europe's €1.2 trillion grid investment challenge by 2040 is commonly framed as a financial challenge. This paper argues that the central obstacle is institutional: Europe's hybrid liberalization model generates a structural mismatch between energy system transformation ambitions and governance capacity.

Drawing on political economy and infrastructure governance theory, this paper develops an integrated governance framework identifying four interconnected failures rooted in the institutional incompatibility between the liberalization paradigm and the coordination requirements of the energy transition. First, we face a liberalization paradox as fixed market outcomes are increasingly imposed on free market platforms, while four competing design logics — geoeconomic, capitalist, ecological, and social-integrative — operate without any hierarchical guidance. Second, permitting bottlenecks reflect not bureaucratic inefficiency but decades of accumulated democratic preferences, requiring a new theory of necessary infrastructure. Third, flexibility governance misframes behavioral adaptation as techno-economic optimization, undermining civic legitimacy at scale. Fourth, grid congestion forces grid operators or regulators into reactive industrial policy decisions without democratic mandate. These failures compound in the financing dimension: incentive misalignments, fiscal deterioration, and fragmented EU instruments produce reactive and inadequate investment.

The framework demonstrates that technical and financial interventions — however substantial — cannot substitute for the institutional reconstruction that transformation requires. As European coordination emerges as a precondition for grid development, the paper raises the fundamental question of whether the era of market liberalization is giving way to a new era of system planning.

Introduction

Electricity grids play a crucial role in achieving climate neutrality by 2050. The transition to renewable energy sources and the electrification of all economic sectors require an unprecedented investment wave of € 1.2 trillion by 2040 in adapted electricity grid infrastructures. € 730 billion is needed for distribution grid investments. Of the total investment of € 472 billion in transmission grids by 2040, more than 70% is due to national transmission infrastructure investments (EC, 2025a). Around €130 billion is expected to be invested in cross-border projects, increased interconnections and offshore connections. As grid infrastructure is in most European countries largely financed through tariffs, meeting these investment needs poses a challenge.

In its recent 'European Grids Package', the European Commission acknowledges that it is imperative that the European Union and all member states collectively '*take decisive action to resolve structural issues in EU energy infrastructure planning and implementation to successfully deliver a genuine Energy Union that enables energy independence, strengthens our competitiveness, drives decarbonization and fosters our energy security* (EC, 2025b).'

This paragraph illustrates how dramatically the world changed since the EU Green Deal of 2019. Originally presented as an ecological transformation project to protect our planetary boundaries, the energy independence and decarbonization objectives of the Green Deal can nowadays be interpreted as pro-active geopolitical considerations. Shortly after the Green Deal, Europe initiated new industrial policy objectives to lower critical interdependencies. Following Russia's 2022 invasion of Ukraine, Europe started to 'industrialize' its decarbonization agenda through initiatives like REPowerEU, the Net-Zero Industry Act, the Critical Raw Materials Act, and the European Hydrogen Bank. These programs complement the earlier 'Fit for 55' package and signal Europe's commitment to deep decarbonization by 2050. The immediate energy price volatility triggered by the American and Israeli strikes on Iran starting in late February 2026 underlined that Europe's fossil fuel dependencies remain a source of strategic vulnerability.

Yet the energy transition has evolved beyond climate or energy security objectives alone. Europe's new approach increasingly reflects modern industrial policy with strategic state intervention initiatives in response to intensifying competition with the US and China. A trend towards deglobalization is illustrated by the multiple calls for technological decoupling, strategic autonomy, and a de-risking of dependencies in critical value chains. Consequently, energy infrastructure investments must now serve multiple objectives simultaneously: supporting climate ambitions while strengthening European sovereignty, enhancing economic competitiveness, reducing dependencies, and fostering strategic alignment with (new) international partners. Given the central role of electricity in all decarbonization outlooks towards 2050, the importance of adapted and resilient electricity grids cannot be overestimated.

As concerns of electricity grid congestion nowadays rise in several countries, the decisions made by European grid companies will not only shape the new low-carbon landscape by 2050 but equally impact the allocation across Europe of new energy-intensive sectors like data centers, battery manufacturing or semiconductor production. Especially countries with robust and flexible grids will be able to attract strategic (energy-intensive) industries. Grid adequacy concerns are not restricted to Europe. In the US, PJM struggles to follow expected load from data center and faces an electricity deficit of 5,2% in 2027-2028. This never happened before. As a drastic 'market intervention', BigTech will be forced to invest in new power plants in the US (CNN, 2026).

The gas price spikes of 2022 and 2023 reduced output from European energy-intensive industries with 15 percent and highlighted that the future of established industries like steel and chemicals in Europe depends on the smooth pace of the energy transition and especially on its total system cost. The Draghi report of 2024 calls for a joint plan for decarbonisation and competitiveness, and warns that poorly coordinated decarbonization policies risk to deteriorate Europe's competitiveness and growth potential (Albrecht, 2025).

The focus on the upfront grid investment challenge risks to neglect the economic value of enhanced energy integration. IMF assessments conclude that enhanced European market integration could lead to annual cost savings of €40 billion, while boosting cross-border electricity trade by 50% could raise annual EU GDP growth by around € 18 billion by 2030 (EC, 2025b). Until 2030, Europe lacks 88 GW of cross-border electricity transmission capacity. Investing € 5 billion in interconnection would reduce total system costs by € 8 billion, creating a net economic gain of € 3 billion (EC, 2025b). While the grid investment challenge is daunting, the opportunity cost of not investing at all risk to be even higher.

Competitiveness concerns should always be balanced with the full benefits of decarbonization. In 2024, the EU imported €375.9 billion worth of fossil energy products, amounting to a total of 720.4 million tonnes (Eurostat, 2025). The energy transition will dramatically lower Europe's fossil fuel imports with its associated inflationary risk. As a transformation project, the energy transition will bring innovation and trigger new economic sectors while the population enjoys health benefits from strongly reduced levels of conventional air pollution. Harnessing these positive externalities requires a solid coordination of the energy transition.

To meet all these objectives, the multi-level governance of the energy transition and grid infrastructure must address multiple challenges. In the next sections, the political economy of a rapid grid expansion is explored while our institutional architecture remains calibrated for incremental change. Major governance challenges stem from the hybrid liberalization of European energy markets. The liberalization paradox and the four design logics of infrastructure planning are examined as drivers of current governance challenges. Grid congestion in essence illustrates the limitations of the European liberalization project, while efforts to prioritize access to congested grids implicitly reintroduce conventional industrial policy. A different but connected challenge relates to the current 'electricity demand plateau'

and its consequences for the pace of the energy transition. Finally, the challenge of how to finance the needed investments and the scope of 'EU support' is explored in the last section.

1. Hybrid liberalization of European energy markets and competing design logics

Modern infrastructure forms the foundation upon which all economic activity depends. Infrastructure represents not merely a support system but the very construction of economic opportunities itself. In the post-war era, national governments selectively built, modernized and coordinated infrastructures in line with the planned evolution of domestic industrial structures (e.g. chemical clusters) and societal objectives. While coordination of national infrastructure development was strong, there was hardly infrastructural coordination at the European level.

As a consequence of the Single European Act (1986), the EU developed in the late 1980s and 1990s a significant infrastructure policy to support the integration of the internal market. At the core of this agenda was the Trans-European Networks (TEN) initiative to coordinate the expansion and interlocking of European transportation, energy and communication infrastructures. Network-related infrastructures were liberalized and sector-specific directives drove the organizational separation of infrastructure and service providers (i.e. the so-called 'unbundling'). With respect to electricity infrastructure, in the 1990s and early 2000s, the focus was on the liberalization of national grids and not on supporting additional cross-border infrastructure.

During the euro crisis, the EU intensified its market-liberal approach to infrastructure policy. Publicly owned energy and transportation infrastructure companies in crisis countries were often sold below market value to consolidate national budgets. Furthermore, budgetary constraints forced several member states to cut back on infrastructure-related investments. After the financial and euro crisis, member states were under pressure to promote growth and further strengthen the internal market. It became increasingly obvious that market forces were unable to allocate resources towards infrastructure under crisis and non-crisis conditions, leading to an interventionist 'infrastructure push' debate to compensate for structural underinvestment in infrastructure (Abels and Bieling, 2024).

In the light of competition with the US and China, the EU launched its New Industrial Strategy in 2020. With respect to energy infrastructure, the Important Projects of Common European Interest (IPCEI) exploit legal opportunities in the EU's state aid rules to promote business endeavors to geoeconomically important technologies. The post-Covid Recovery and Resilience Facility (RRF) was equally designed to accelerate infrastructural transformation through public investment.

While the EU gradually explores more interventionist infrastructure policies – partly in response to infrastructure underinvestment as a failure of liberalized markets -, the energy landscape implicitly became heavily regulated since the Third Liberalisation Package of 2009. Energy markets have been gradually liberalized to empower market forces – with policymakers as passive observers of free market dynamics-, but electricity market outcomes such as the evolution of CO_2 emissions, the share of renewable energy sources and energy efficiency savings in all sectors have been regulated by the same policymakers. This liberalization paradox of fixed market outcomes from a free market platform illustrates the limited or difficult coordination between DG Competition, DG Energy and DG Climate Action.

Before the liberalization of energy markets, vertically integrated utilities together with local distribution companies served national markets in a regulated and coordinated environment. In most countries, the minister of economic affairs approved investment plans of energy-intensive industries and coordinated these with investment plans and tariff proposals from utilities to ensure sufficient generation capacity. The final price of electricity for households, small businesses and energy-intensive industries was regulated. A fixed electricity price for energy-intensive industries was essential to trigger investments. This corporatist collaboration between the state, large industries and the energy sector ensured a stable and highly predictable increase of electricity demand in the decades before liberalization.

In the post-liberalization landscape, the vertically integrated monopoly or oligopoly companies have been dismantled. Coordination between the state, industry and the energy sector has been largely replaced by the belief in the allocative and dynamic efficiency of free market forces. Yet just as the liberalization of energy markets neared completion, Europe launched its ambitious decarbonization agenda towards 2050. As the envisioned electrification across all economic sectors brings new uncertainties, a strong and sustained coordination of electricity demand, intermittent renewable generation, grid expansion and flexibility provision is required. This raises the fundamental question of how this type of coordination can be organized. Can this unprecedented transformation be managed through market mechanisms alone, or does it require forms of interventionist coordination that reach beyond current regulatory frameworks? Or differently stated; are decarbonization trajectories best supported by free market platforms or by centrally planned coordination between electricity demand and supply?

The liberalization of European energy markets did not follow neo-classical recommendations from an economic textbook. The debate on a more interventionist 'infrastructure push' is not yet settled. A rather hybrid interpretation of the interaction between liberalization and infrastructure policies is however not surprising since '*infrastructures are political, as they are subject to competing or complementary design logics, backed by different social interest groups and alliances* (Abels and Bieling, 2024).' In infrastructure and energy policy, differences in design logics can emerge in the planning, financing and regulatory phases of policymaking. Different design logics equally explain very different positions in public debate on the energy transition. Abels and Bieling (2024) differentiate between four design logics that can be mutually reinforcing or competing;

1. The geoeconomic design logic as primarily promoted by the European Commission and several national governments. In this logic, infrastructures are networks to consolidate transnational value chains and are geared towards outperforming international competitors in the race for key markets and technologies. Electricity grids should support the economic competitiveness of European companies and accommodate new sectors with a high value added (e.g. datacenters).
2. The capitalist design logic where infrastructure presents investment opportunities that can mobilize large volumes of capital from profit-seeking agents. This logic risks prioritizing projects with the highest profit potential above projects with the highest strategic and societal value.
3. The ecological design logic that aims to optimize the energy and climate balance of infrastructure and the connectivity generated by them. This logic is embedded in a broader discourse on sustainable development.
4. The social-integrative design logic aims to improve democratic control, participation and social cohesion. This logic views infrastructure as prerequisites for the provision of essential public goods, while the difficulties from rapid structural change should be eased by e.g. employment programs or support schemes for the lower incomes. The 'just transition' concept fits into this social-integrative design logic.

These design logics manifest differently in electricity grid governance. The geoeconomic logic prioritizes grid capacity for strategic industries like data centers, batteries or semiconductors. The capitalist logic favors profitable grid connections over better grid services in rural or disadvantaged areas. The ecological logic demands grid flexibility for renewable integration and energy communities. The social-integrative logic requires affordable access and just distribution of costs. Grid companies must navigate these competing demands without clear political guidance on priorities. While we all can agree that massive grid investments are essential, we will not all think along with identical design logics.

While EU infrastructure policy departs from geoeconomic logic in planning, capitalist logic often dominates implementation (Abels and Bieling, 2024). The Gaia-X cloud project illustrates this tension: initiated by France and Germany to create autonomous European cloud infrastructure, its reliance on private financing allowed major US providers to become key participants, undermining strategic autonomy. Although industrial interventionism should subordinate profit opportunities to broader geoeconomic objectives, current governance structures often fail to enforce this hierarchy.

In December 2025, the European Commission launched its European Grids Package and the Energy Highways initiative: '*The Grids Package marks a new approach to energy infrastructure by bringing a truly European perspective on infrastructure planning, while accelerating permitting procedures and ensuring a fairer division of costs regarding cross-border projects* (EC, 2025b).' With electrification central in decarbonization roadmaps and electricity grids as the backbone of energy infrastructure, why has a truly European perspective on infrastructure planning been postponed until 2025?

The Commission is proposing cost-sharing and bundling of multiple Projects of Common Interests (PCIs) and Projects of Mutual Interests (PMIs) as additional ways of financing. The current grid planning framework under the TEN-E Regulation strongly advanced the coordination and development of cross-border energy infrastructure projects. The Connecting Europe Facility (CEF), the EU's main funding instrument for cross-border energy, transport and digital infrastructure, has backed 124 PCIs and PMIs with EUR 8.4 billion since 2014, unlocking at least EUR 15.8 billion in private investments (EC, 2025b). The European Commission however stresses that further action is imperative to ensure seamless coordination across national, regional and EU governance levels and across sectors, to ensure a fully optimized and interconnected grid. A more coordinated and robust identification of needs is essential to ensure '*projects align with current and future European objectives* (EC, 2025b)'. The European Commission further adds that stronger coordination between national and European planning is essential and should initiate a 'gap filling' process to maximize the benefits of new cross-border capacity. Is this another plea for central planning?

Increasingly integrated cross-border energy infrastructures deliver benefits beyond the territories where they are built. This makes fair and transparent cost-sharing essential to avoid disproportionate burdens on local consumers. To tackle this, the European Grids Package aims to provide more transparency and fairness in the way costs and benefits are assessed. Bundling infrastructure projects can also make financing easier, for example through the establishment of special purpose vehicles, thereby attracting additional investment. Scaling up financial support is key and as part of the 2028-2034 Multi-annual Financial Framework, the Commission proposed a five-fold increase of the CEF Energy budget from €5.84 billion to €29.91 billion.

2. Permitting and social license: the political economy of grid expansion

Across Europe, grid expansion confronts a paradox: investment capital is often available, but permits are not. Transmission projects routinely face 7–10-year approval timelines, with local opposition creating bottlenecks in densely populated areas where grid reinforcement is most urgent for decarbonization and energy security.

The European Commission's Grid Action Plan of 2023 and the proposed reforms in the 'European Grids Package' of 2025 aim to accelerate permitting through streamlined procedures and designated priority corridors. This framing suggests that lengthy timelines represent a discretionary administrative choice. It implies that political will alone could compress years of consultation into months. This is wishful thinking as permitting duration in essence reflects an embedded institutional logic, not bureaucratic inefficiency. Whether we like it or not, lengthy procedures embody decades of accumulated societal preferences: participatory democracy, environmental safeguards, property rights protection, and precautionary risk assessment. These are essential features - not bugs - of mature liberal democracies. The pace at which we permit infrastructure reveals what we truly value when

trade-offs become concrete. A structural mismatch emerges when the policy discourse demands urgent transformation and rapid decarbonization while our institutional architecture is calibrated for incremental change and exhaustive deliberation.

Grid infrastructure furthermore exhibits extreme asymmetries. The benefits are diffuse and abstract – system efficiency, energy security, decarbonization, market integration – but the costs are concentrated, immediate and tangible. Communities are asked to bear visible costs for systemic benefits they cannot directly capture. In previous eras, technocratic authority and centralized planning provided sufficient legitimacy. The post-war construction of Europe's energy infrastructure—including nuclear plants and high-voltage corridors — proceeded with limited consultation, justified by reconstruction imperatives and the authority granted to technical experts. That social contract has eroded. Citizens now expect genuine participation, not performative consultation. This is what the 'social license to operate' truly means: not stakeholder management, but the normative grounds on which collective transformation can legitimately impose localized burdens. Citizens now demand evidence-based risk assessment, not reassurances. They invoke environmental principles and property rights with legal sophistication. Accelerating permitting without addressing this legitimacy deficit risks either: (a) judicial challenges that ultimately extend timelines, or (b) authoritarian shortcuts that undermine democratic norms.

If Europe is serious about grid expansion at the pace climate and energy security objectives require, policy must move beyond administrative efficiency toward distributional innovations like benefit-sharing mechanisms. This requires moving beyond one-off compensation toward structural revenue-sharing from grid-enabled energy flows or industrial development. Models of municipal equity stakes in wind projects offer some precedent. The formal acknowledgment that infrastructure hosting constitutes a contribution to collective goods implies a debate on proportional advantages, e.g. reduced tariffs or access to regional/local investment funds.

Ultimately, permitting speed is a proxy for a more uncomfortable inquiry: Can liberal democracies execute large-scale infrastructure transformation while maintaining procedural legitimacy? The answer is not obvious. An authoritarian acceleration is not a viable or desirable model, but neither is indefinite incrementalism when climate physics imposes hard deadlines. Europe's permitting challenge is therefore conceptual as much as administrative. We need a democratic theory of necessary infrastructure that can legitimate concentrated burdens to support collective transformation, without abandoning the participatory norms that define liberal governance. As the current regulatory framework reflects our civilization's democratic commitments, accelerating deployment requires redesigning institutions to make trade-offs explicit and benefits tangible.

3. Beyond steel and copper: the governance of adaptive infrastructure

Grid modernization increasingly relies on 'behavioral infrastructure' such as demand response systems, smart meters, vehicle-to-grid integration, distributed battery storage, and dynamic load management. Unlike steel pylons crossing landscapes, these technologies require diffuse participation across millions of households and businesses, fundamentally shifting the governance question from 'who accepts infrastructure in their community' to 'who adapts behavior in their daily life, and on what terms'.

Current policy discourse treats flexibility primarily as a techno-economic optimization problem: smart meters, real-time pricing, and aggregation platforms will generate sufficient price signals to activate rational actors. This assumption is profoundly naïve. Behavioral adaptation involves privacy concerns, comfort sacrifices, capital requirements, cognitive burdens, and risk exposure under dynamic contracts. Flexibility is not merely a market transaction as it represents a reordering of domestic life and citizen-state relations.

Grid flexibility generates substantial system value—deferred infrastructure investment, congestion relief, renewable integration—captured primarily by system operators, aggregation platforms, and large industrial consumers. Meanwhile, households and small businesses providing flexibility receive marginal compensation bearing little relation to the system value created. This asymmetry is compounded by structural inequality: flexibility markets favor those who can afford to participate.

From a governance perspective, this raises the question of what behavioral burdens citizens can be asked to bear in support of the energy system transformation, and what reciprocal obligations this creates. Current policy evades this by treating flexibility as voluntary market participation. But this voluntarism is increasingly fictional. As grids become smarter and more dependent on demand-side resources, non-participation becomes progressively costly or impossible.

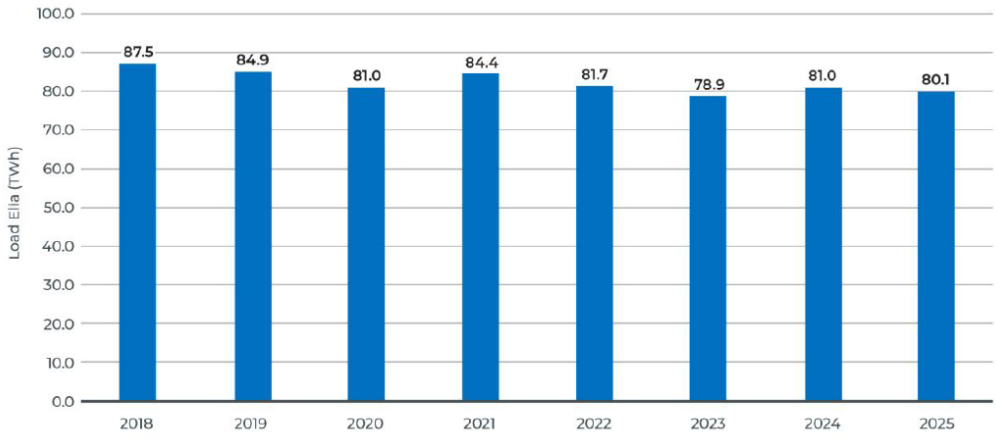
Legitimate flexibility governance requires moving beyond market voluntarism toward explicit recognition of flexibility as a civic contribution to collective infrastructure, with corresponding entitlements and protections. Europe's flexibility governance must navigate between technocratic imposition and market voluntarism, neither of which can generate legitimate transformation at scale. This requires institutional innovation that embeds democratic participation, distributional fairness, and individual protection directly into smart grid architecture, not as afterthoughts to technical deployment.

4. The evolution of electricity demand

With the coordination of electricity demand and supply as a prerequisite for a smooth and predictable energy transition, grid companies struggle to predict the evolution of electricity demand in the coming years and decades. All decarbonization scenarios towards 2050 project substantial growth in electricity demand in Europe, with some scenarios anticipating a doubling or even tripling of current consumption. The large-scale electrification of road transport could increase total electricity demand by 15-25% in most countries, while the combined electrification of transport, heating, and industrial processes will drive far greater growth. Yet current trends tell a different story: total electricity demand in Europe has stagnated or declined in recent years.

Figure 1 shows that the total load on Belgium's Elia network stabilized around 80 TWh since 2020, approximately 8% below 2018 levels. This unexpected stability reflects primarily energy efficiency improvements and industrial restructuring, though it masks nascent electrification in transport (<5% EV penetration) and heating.

Figure 1 – Belgium: total load Elia (TWh)



source: Elia (2025). Elektriciteitsmix 2025. Persbericht 26 december 2025

Similar patterns emerge across Europe. In the Netherlands, total electricity consumption peaked at 123 TWh in 2008 and has declined to 119 TWh in 2018 and approximately 115 TWh in 2023 and 2024 (CBS, 2025). So while grid planning must anticipate a strong and unprecedented increase of electricity demand, this challenge is compounded by the unexpected current demand plateau.

Although the economies of Belgium and the Netherlands are comparable, their outlooks with respect to the evolution of electricity demand do not converge at all. Table 1 shows the expected evolution of total electricity demand between 2023 and 2035 in recent publications by the Belgian and Dutch TSO or network organizations. This table illustrates how different

scenarios lead to huge differences in expected demand in just one decade. In their key publications on adequacy, both the Belgian and Dutch TSO expect a strong increase of electricity demand by 2035. Elia presents several scenarios, each leading to a significant growth of demand but significantly below the expected growth as foreseen by TenneT. A much higher growth outlook for the Netherlands is presented by Netbeheer Nederland in its FIEN+ report. This report projects a total electricity demand between 366 and 565 TWh in 2050, what is a truly staggering increase.

Table 1 – Projected evolution of electricity demand by 2035 in Belgium and the Netherlands

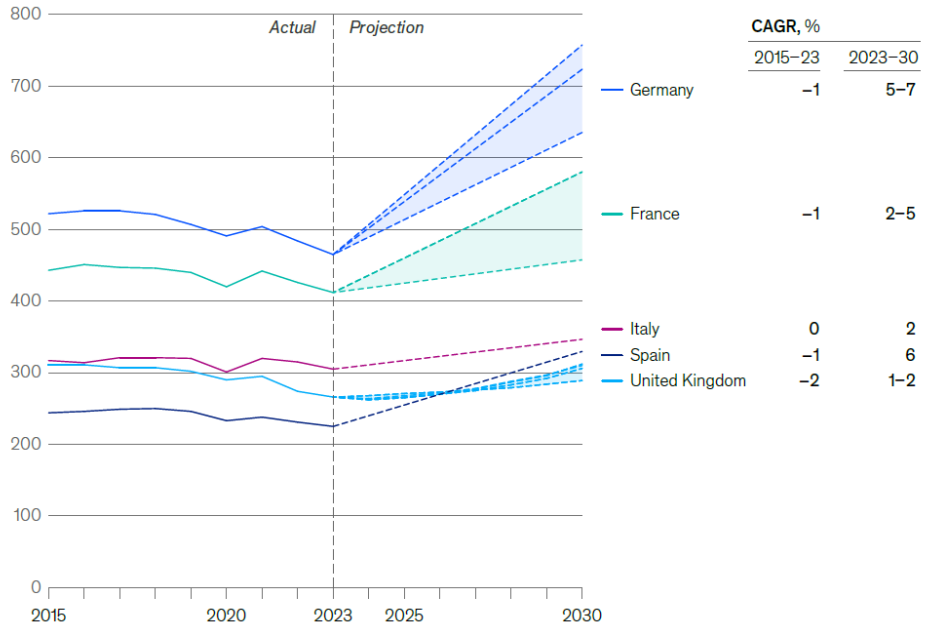
	2023/25	2035	Growth 2035/2023
Elia (BE)	80-82 TWh	110-130 TWh	+ 37% / + 57%
TenneT (NL)	115 TWh	190 TWh	+ 65%
Netbeheer Nederland ('FIEN+) (NL)	115 TWh	Approx. 270-310 TWh	+ 134% / + 169%

sources: Elia (2025). Adequacy and flexibility study for Belgium 2026-2036 / TenneT (2025). Monitor Leveringszekerheid 2025 (EPN-2025-022) / Netbeheer Nederland (2025). Financiële Impact Energietransitie voor Netbeheerders ("FIEN+")

Table 1 highlights the relevance of the famous quote, often attributed to Niels Bohr: *'Prediction is difficult, especially about the future*.' Persistent uncertainty on the evolution of electricity demand can affect power infrastructure investment plans.

At the end of 2024, McKinsey warned that up to 40 percent of modeled growth of electricity demand by 2030 may not materialize as a result of elevated prices, efficiency gains and economic changes linked to industrial restructuring. Figure 2 shows the modeled net electricity demand for five European countries up to 2030, and the associated annual growth rates (CAGR). These government projections reflect the EU's net-zero commitments in REPowerEU or REDIII. The REPowerEU initiative includes ambitious heatpump targets by 2030 but European heatpump producers reported strongly declining sales in 2024 (McKinsey, 2024). Also the growth in demand for electric vehicles has been sluggish in the last years, due to reduced support schemes in many countries. The introduction of more affordable models with an attractive range may revive momentum in the coming years. When it comes to industry, the high energy prices of the last years did lead to plant closures and announced plant closure. A further 10 percent reduction of steel and chemical output by 2030 could materialize and contribute to a lower electricity demand (McKinsey, 2024). Another concern relates to already constrained grids having a negative impact on possible investments in data centers.

Figure 2 – Net electricity demand projections (TWh)



source: McKinsey (2024). Electricity demand in Europe: Growing or going (October 2024)

The current demand plateau provides a strong incentive to maximize the use of existing infrastructure before investing in new capacity. In line with the 'energy efficiency first' principle, a greater uptake of smart electricity grids, innovative and digital technologies and network efficiency measures contribute to affordable electricity, while a later expansion is further prepared. According to ACER, the use of grid-enhancing technologies can increase overall network capacity in Europe by 20% to 40% by 2040 while delivering cost reductions by 35% compared to traditional network expansion by 2040 (EC, 2025b). Examples of such grid-enhancing technologies include dynamic line rating (DLR) systems, which use real-time weather data to increase the capacity of existing transmission lines by 10-40%, and power flow control devices that actively route electricity through the most efficient network paths. Belgium's TSO Elia has deployed dynamic line rating on 27 lines including all high-voltage interconnection lines, achieving thermal ratings of more than 200% of seasonal capacity during favorable wind conditions. Despite its potential, dynamic line rating is still significantly under-utilized in Europe (Enlit, 2025).

A lower-than-expected electricity demand growth in Europe could significantly impact overall system costs and the path of the energy transition. Although demand for electricity could vary by 20 percent or more, Europe's renewable generation targets are fixed. In many countries contracts for difference (CfDs) have been designated as the best-practice state instrument for providing direct price support to renewable generation technologies. CfDs derisk renewables: when the reference price — typically the day-ahead price on European trading platforms — falls below the strike price, CfD holders receive a premium to

compensate for the difference. This downside risk is assumed by the CfD counterparty. States pay out the difference and will recover it from consumers, present taxpayers or future generations. Heussaff and Zachmann (2024) warn that with a drop in electricity demand, Germany's annual CfD costs could triple from € 6.7 billion to a total level of € 23.5 billion. This type of exposure for states raises the question whether supply-side power system investments entail substantial fiscal risks. From this perspective, policies to accelerate electrification and boost demand would not only help with emissions mitigation but would also be fiscally prudent.

To mitigate these and related risks, all stakeholders across the energy chain need to monitor trends and adjust their strategies proactively in several interconnected key areas;

- Power generation assets: Overcapacity can increase system costs and pose an affordability challenge. A 10 percent reduction in power demand could put up to €300 billion in planned generation investments at risk between 2025 and 2030 — approximately 30 percent of the expected total — potentially resulting in overcapacity, stranded assets, and higher system costs (McKinsey, 2024).
- Grid buildouts and market frameworks: A shift from 'conventional' local grid build-out to investments in interconnection, grid automation, digitalization, microgrids and energy storage could be explored to ensure cost-effective deployment. New market frameworks are needed to support value creation from increased flexibility when demand slows down.
- Consumer impact and pricing: A lower demand can lead to reduced wholesale prices and a weaker business case for power generation investments. When the cost of support mechanisms for new renewable capacity ends up in network tariffs, final consumer prices might increase.

McKinsey concludes its analysis on the implications of a reduced power demand with '*utilities, T&D companies, governments, and investors need to realign their strategies with regularly updated demand forecasts … This need for increased agility will place strategic and organizational demands on both companies and regulators, ideally resulting in more robust systems for the future* (McKinsey, 2024).' McKinsey does not advocate for pan-European coordination of industrial expansion, sectoral electrification strategies (e.g. heatpumps,…) and network and renewable capacity investments. Several difficult questions relate to agency or governance issues; who should coordinate these transformational trajectories, what type of mandate is applicable and who should allocate and revoke this mandate? This type of recommendation is at odds with the philosophy of liberalized markets.

Heussaff and Zachmann (2024) conclude their analysis on the fiscal impact of CfDs and the supply-demand mismatch risk as follows: '*A cost-efficient, managed transition will require European coordination of electricity supply, demand and network investments. Clean electricity supply and demand should be synchronized through a combination of state interventions and market mechanisms. Undersupply of clean power will mean a failure to meet climate targets, but oversupply can be costly too* (Heussaff and Zachmann, 2024). With European coordination

emerging as a precondition for transformation, is the era of market liberalization giving way to a new era of system planning?

5. Grid congestion and reactive economic planning

The Netherlands currently deals with severe grid congestion although total electricity demand is rather flat (approximately 115 TWh). With close to 16,000 companies waiting for connections, grid congestion blocks new investments and increases the cost of electricity. In addition to a severe drag on the Dutch economy, grid congestion became a major bottleneck to the energy transition and raises energy security concerns. Table 1 showed that the Netherlands needs to fix current congestion issues while preparing for a strong increase of electricity demand in the next decades.

The Dutch congestion crisis challenges the ability of liberalized market to accommodate rapid structural transformation. The first signs of congestion emerged in 2018, upon feed-in from solar photovoltaic parks in Drenthe and Groningen. Since then, the Netherlands became a world leader in solar power with a five-fold increase in solar PV capacity between 2018 and 2023, driven mainly by distributed rooftop installations supported by a very favorable net metering policy scheme (IEA, 2025). Net metering creates additional pressure on an already overburdened grid while in the same period, there has been a surge in grid demand from large energy users, reflecting rapid economic growth and strong government incentives to reduce CO_2 and lower gas consumption. Energy-intensive industries using lower-temperature processes electrified their operations earlier than planned. Finally, Northern Holland experienced a housing construction boom to meet general housing scarcity while hosting new data centers at the end of major intercontinental internet connections (RAP, 2024). Although these developments obviously impacted peak demand and demand volatility, total electricity demand remained flat.

The Dutch congestion case illustrates that economic incentives impacted behavior - maybe more than intended – but clearly have been designed in a fragmented policy environment. Solar PV expansion, industrial electrification, data center investments, and housing construction each responded to distinct policy incentives and economic drivers, with no coordination mechanism ensuring their impact on electricity demand remained within grid capacity constraints. The liberalized market framework provided no institutional architecture for this essential coordination. Its underlying logic actively resists such intervention as distortionary.

Grid congestion is not merely a technical bottleneck but a manifestation of competing design logics operating simultaneously without hierarchical guidance. The ecological design logic drove aggressive solar deployment through net metering subsidies, prioritizing renewable capacity expansion. The geoeconomic logic attracted data centers to strengthen digital infrastructure competitiveness. The social-integrative logic demanded housing construction

to address acute scarcity. The capitalist logic directed each investment toward its highest private return, independent of grid capacity constraints. Without political prioritization among these logics, grid operators face the impossible task of accommodating all claims simultaneously.

There are multiple options to address grid congestion, ranging from increasing flexibility of grid users to mandatory participation in congestion management, capacity limitation contracts, connection sharing, releasing unused contracted capacity, network regulation and tariff reforms, new frameworks for local energy systems, and accelerated grid expansion. But addressing grid congestion while electrification further expands remains fundamentally an investment and coordination challenge. The Dutch estimate that 15,000 additional substations are needed by 2030 while 80,000 kilometres of additional cables will be required by 2050 (RAP, 2024).

The deeper challenge emerges in the allocation of scarce grid capacity—a problem that exposes the ideological contradictions embedded in Europe's hybrid liberalization model. Dutch policy makers are in the process of establishing a list of priority projects for which swift grid connections are of national importance, such as offshore wind parks, new strategic industries or projects with important social functions (e.g. new hospitals). It proves to be challenging to construct 'optimal 'priority lists as each new project to connect will offer some type of economic or social benefit. How can we compare the societal or economic value added by a battery park, a semiconductor plant, a new mega-hospital, a large social housing project in a region with housing scarcity, a new major school campus in a deprived area, and so on? And who should make this comparison and decide upon the criteria used? Can we expect that a grid company or a small unit at the ministry of economic affairs somehow decides about all possible investments?

This allocation dilemma reveals the fundamental tension between the liberalization ideology and the more recent transformation necessity. Liberalized markets were designed to depoliticize infrastructure through technocratic regulation, removing politically contentious allocation decisions from ministerial discretion. Yet the energy transition reintroduces precisely the political choices liberalization sought to avoid: which economic sectors deserve priority access to scarce infrastructure, which regions should host new capacity, and which social objectives justify delaying profitable investments.

The prioritization challenge is not merely administrative but conceptual. In the pre-liberalization era, the corporatist model was criticized for opacity, rent seeking and elite capture but at least provided clear institutional responsibility for coordinating long-term infrastructure with economic development. The liberalized framework transferred these decisions to regulators, grid operators or bureaucrats who now find themselves making allocative choices with profound distributional consequences but without any democratic mandate or political accountability.

The current prioritization approach treats grid capacity as a passive constraint to be managed, rather than as a strategic asset to be deployed. Grid capacity allocations represent

de facto industrial policy. Prioritizing battery manufacturing over data centers shapes Europe's technological trajectory. Yet these choices are being made reactively by grid operators applying quasi-technical criteria, rather than proactively by governments articulating strategic economic visions. This reactive stance reflects liberalization's enduring influence even as its premises collapse under transformation pressures. The Netherlands faces not merely a grid crisis but a governance crisis: liberalization's institutional architecture cannot execute the coordination functions that transformation demands, yet political systems remain reluctant to acknowledge that demand-reactive infrastructure provision has failed.

The international dimension compounds these domestic coordination failures. Cross-border electricity flows increasingly determine national grid adequacy, yet each member state plans infrastructure primarily for domestic objectives. As highlighted in the earlier discussion of hybrid liberalization, this reflects the enduring tension between geoeconomic logic at the European level and capitalist logic in national implementation. Each country pursues strategic autonomy in energy-intensive sectors while simultaneously depending on neighbors' grid investments to manage domestic supply-demand imbalances.

The Dutch congestion crisis thus illuminates a broader European challenge: the energy transition requires coordination at scales and speeds that liberalized market structures cannot deliver, yet political systems lack the institutional capacity—or perhaps political willingness—to reintroduce the directive planning mechanisms that transformation arguably demands. The question is not whether markets or states should coordinate infrastructure investment, but rather what hybrid governance models can combine market efficiency with strategic direction, ensuring that grid expansion serves democratically determined priorities while maintaining the discipline that competitive pressures provide.

6. How to finance grid infrastructure investments?

Given the pivotal role of electricity grid infrastructure in addressing multiple socio-economic challenges, the smooth and adequate financing of grid investments is a precondition for a cost-efficient energy transition. Grid infrastructure has extraordinarily long investment horizons—assets lasting 40-60 years or more—while private capital markets typically demand shorter payback periods and higher returns to compensate for perceived risks. In the predictable environments of the past, financing grid investments on private capital markets went smoothly. The combination of the current high interest rate environment and the challenging new context for grid operators risks increasing the cost of capital.

The liberalization of energy markets in Europe aimed to create competitive pressures to boost efficiency and innovation. Grids however provide public services and remain natural monopolies, requiring a complex regulatory apparatus to simulate 'market discipline'. The regulatory overhead itself adds costs without necessarily delivering the promised

efficiencies. The resulting incentive structure is more structurally distorting than a simple investment bias. Under rate-of-return regulation — the dominant model across European grid operators — the Averch-Johnson effect creates systematic incentives to expand the regulated asset base, since returns are calculated as a percentage of capital invested. This does not produce overinvestment per se, but investment distortion: operators favor capital-intensive physical infrastructure that maximizes the conventional regulated asset base over novel lower-cost alternatives such as grid-enhancing technologies, demand-side flexibility, or preemptive capacity investments with uncertain future utilization. The energy transition requires precisely the latter — adaptive, anticipatory investment aligned with transformation objectives rather than conventional asset base maximization. This tension reflects the broader contradiction examined in the liberalization section: Europe's hybrid market model applies a regulatory logic calibrated for incremental asset management to a sector requiring strategic, coordinated transformation.

With grids as natural monopolies, most European grid companies are fully or partly owned by national governments. Fully state-owned grid entities like RTE (EDF) in France, Energinet in Denmark, Stattnet in Norway or Svenska Kraftnät in Sweden can potentially rely on state backing, sovereign guarantees, or state-supported financing mechanisms. In addition to publicly controlled system operators, Europe's patchwork of grid companies includes publicly listed 'close to' private companies and hybrid entities (like Elia in Belgium). When private and hybrid operators turn to capital markets to finance new investments, they typically face higher interest rates than fully state-owned operators in countries with strong sovereign credit ratings.

The regulated WACC—the Weighted Average Cost of Capital that determines what return grid operators may earn on their investments—has historically ensured relatively low financing costs for private and hybrid companies. However, transferring the massive grid investment costs needed up to 2040 into consumer tariffs faces growing political and affordability constraints. As discussed in the context of behavioral infrastructure and flexibility governance, citizens already bear substantial burdens from the energy transition. Adding steep tariff increases to finance grid expansion on top of these demands risks exhausting public acceptance, particularly when the benefits remain diffuse and long-term.

With the regulatory advantage of a stable WACC under pressure, private and hybrid companies may face a significant risk premium in the next decade. This dynamic threatens to create a two-tier financing landscape: state-owned operators in high-creditworthiness countries access cheap capital while private and hybrid operators in fiscally-constrained countries face expensive financing—precisely inverting the efficiency logic that justified liberalization.

Norway presents a fascinating paradox as it combines a highly market-oriented and innovative electricity market design with 100% state ownership of infrastructure. With Nord Pool in 1993, Norway was a pioneer in creating competitive wholesale electricity markets and one of the first countries to enjoy full retail competition with numerous suppliers competing for customers. Norway has a long tradition of dynamic pricing retail contracts,

cross-border trading and financial markets with sophisticated electricity derivatives and hedging instruments. State ownership of grid infrastructure does not preclude innovation at all. Indeed, the Norwegian model suggests that the dichotomy between market efficiency and public ownership is false: infrastructure can be publicly controlled while service provision remains competitive and innovative.

With 45% municipal ownership and 55% free float, Belgian TSO Elia cannot simply rely on public budgets and must attract private capital to finance its investments. It faces market discipline; i.e. private investors demand competitive returns and carefully assess risks. Companies like Elia must convince private shareholders and bondholders that grid investments will generate adequate returns despite the challenging uncertainties of the next decades of the energy transition. It would however be shortsighted to conclude that 100% publicly owned grid companies will enjoy low capital costs because of government backing. Unfortunately, the needed grid investments coincide with a very challenging budgetary outlook for most European countries. Direct government financing of state-owned grid companies faces mounting constraints as EU public finances deteriorate. In Europe, public debt is projected to climb from 80.7% of GDP in 2024 to nearly 90% by 2026, while budget deficits are expected to widen rather than narrow (Council of the European Union, 2025). With new fiscal rules reinstated and eleven member states already exceeding the 3% deficit threshold, most European governments have limited capacity to absorb massive grid investment costs. This fiscal squeeze is particularly severe in high-debt countries, where state-owned TSOs must compete for scarce public resources alongside surging defense spending and green transition commitments.

This fiscal reality creates cruel irony. Precisely now when the coordination failures of liberalized markets become undeniable fiscal constraints prevent governments from reasserting the directive role that transformation arguably requires. The geoeconomic design logic demands strategic infrastructure investments to secure competitive advantage, yet capitalist logic dominates implementation because states lack fiscal capacity to subordinate private returns to collective objectives.

The prospect of strongly increasing infrastructure investments triggered a debate on network tariffs as the key vehicle to recover investment costs. Can the €1.2 trillion investment wave by 2040 be recovered by an increase of tariffs? In its coalition agreement, the new German government announced the launch of a new special fund of €500 billion to finance infrastructure and climate neutrality investments (CDU-CSU-SPD, 2025). Only the low interest rate to finance this fund will end up in the budget of the new government while German consumers and companies are shielded against further network cost increases.

Germany's approach represents a significant departure from the tariff-based recovery model that has dominated European grid financing. By moving costs off-balance-sheet into a dedicated fund, the government effectively socializes financing costs across the tax base rather than concentrating them on electricity consumers. This has profound distributional implications. Tariff-based recovery disproportionately burdens lower-income households, for whom energy costs represent a larger share of disposable income, as well as energy-

intensive industries whose competitiveness depends on electricity prices. Tax-based financing distributes costs more progressively but is also obscures the true cost of grid infrastructure and weakens price signals that could drive efficiency and especially flexibility.

The German model also illustrates how financing mechanisms embody political choices about which design logics should prevail. Shielding consumers and industry from tariff increases prioritizes the social-integrative logic (affordability, just transition) and geoeconomic logic (industrial competitiveness) over the capitalist logic that would require full cost recovery through user charges. It acknowledges that grid infrastructure serves collective transformation objectives that cannot be efficiently financed through individualized user payments.

With the affordability of electricity as a priority, alternative funding opportunities are explored to avoid steep network tariff increases. The fiscal squeeze in high-debt countries triggers strong interest in European funding opportunities. The European Commission recognizes this challenge in its recent Grids Package of 2025 and distinguishes between 'national funding support' and 'EU support' mechanisms (EC, 2025a).

'National funding support' applies to infrastructure where costs can be adequately met through state aid, user-based tariffs, or local mechanisms, without requiring EU-level intervention. The Clean Industrial Deal of February 2025 explicitly refers to state aid at times with energy price spikes. In contrast, 'EU support' is assigned to infrastructure where national support alone is likely to be insufficient, necessitating EU-level funding or support mechanisms to address significant financial risks, private financing gaps, or economic disparities across Member States. This categorization considers factors such as regulated versus non-regulated asset status, ownership models, financing structures (on-balance sheet vs. off-balance sheet), and variations in Weighted Average Cost of Capital (WACC) among Member States.

Table 2 presents per infrastructure category a risk assessment and types of funding support. The connection between risk levels and funding in Table 2 is based on a literature review and expert insights from financial and energy domains (EC, 2025a). It shows that European support for national transmission and distribution infrastructure with limited risks is unlikely, especially for high-income countries. For low-income countries, European support to avoid steep tariff increases is possible. For infrastructure with a significant cross-border impact and hence positive externalities, European support is legitimate to secure transnational economic benefits.

This prioritization of EU-support is economically rational—European funding should address market failures that national mechanisms cannot resolve—but it creates perverse incentives. National governments facing fiscal constraints may deliberately underinvest in domestic grid capacity, knowing that resulting congestion and affordability crises could unlock EU funding. Alternatively, they may prioritize cross-border projects with EU co-financing potential over domestic infrastructure with higher national value but lower European visibility.

Table 2 – Funding and risk assessment per infrastructure category

Infrastructure category	Risk assessment	Type of possible funding support and other notes
Electricity transmission infrastructure	Low/ Medium	Typically financed via regulated returns, with EU financial support considered in specific circumstances, such as mitigating socially unfeasible tariff increases
Electricity distribution infrastructure	Low/ Medium	Typically financed via regulated returns, with EU support playing a role where tariff increases to end users are socially unfeasible
Electricity transmission lines with significant cross-border impact infrastructure	Medium/ High	Possible national and EU support, notably accounting for the positive externalities and EU added value
Electricity transmission lines related to offshore generation	Medium/ High	Possible national and EU support
Electricity storage directly connected to high voltage transmission and distribution lines	Medium	Possible national and EU support

source: European Commission (2025a). Investment needs of European energy infrastructure to enable a decarbonised economy. Final report

The emphasis on cross-border infrastructure reflects the geoeconomic design logic at EU-level while potentially neglecting the social-integrative and ecological logics that operate more strongly at national and local levels. Interconnection capacity serves European market integration and strategic autonomy objectives, but may not address the distribution grid bottlenecks that block heat pump installations, or delay social housing electrification. The financing framework thus risks reproducing the coordination failures identified in the congestion analysis: investments flow to projects that align with available funding mechanisms rather than to those that address the most binding constraints on transformation.

European support for infrastructure investments can have multiple formats, ranging from conventional Multiannual Financial Framework (MFF) funding and guarantee schemes to blended finance, green bonds and revised state aid rules. European support can be important for newer technologies and cross-border activities, where developments are difficult to predict. The type of financing support depends on the type of infrastructure and the country conditions, but generally it can be in the form of grants, EU-backed loans and guarantees or

equity. Mechanisms similar especially to the Connecting Europe Facility for energy (CEF-E) for cross-border investments, and Modernisation Fund, Cohesion Fund, European Regional Development Fund, and Innovation Fund are expected to play an important role in the development of those types of energy infrastructure.

The multiplicity of EU financing instruments—CEF-E, Modernisation Fund, Cohesion Fund, ERDF, Innovation Fund—reflects bureaucratic layering rather than coherent design. Each instrument serves distinct constituencies, operates under different eligibility criteria, and embodies different political compromises from successive treaty negotiations and budgetary cycles. For grid operators and member states, navigating this fragmented landscape requires substantial administrative capacity, creating barriers that favor large, well-resourced countries over smaller or less institutionally sophisticated member states.

This fragmentation also prevents strategic alignment across financing instruments. A cross-border transmission project may secure CEF-E funding while the domestic grid reinforcements necessary to utilize that capacity remain unfunded because they fall outside CEF-E's cross-border mandate and the member state lacks national resources. The permitting section highlighted how infrastructure benefits are diffuse while costs are concentrated. The financing architecture compounds this asymmetry by providing European support for infrastructure that serves European objectives while leaving member states to finance the complementary domestic investments that capture those benefits locally.

Financing mechanisms cannot be designed in isolation from the broader transformation trajectory. The analysis of demand evolution demonstrated that the pace of electrification remains deeply uncertain while the congestion case showed that uncoordinated policies create infrastructure mismatches. The discussion on flexibility governance revealed that behavioral adaptation cannot be assumed. Financing frameworks must therefore be adaptive and capable of responding to demand scenarios, technological developments, and policy changes that cannot be predicted at the investment decision point.

Current EU financing instruments, however, operate on multi-annual programming cycles with fixed eligibility criteria, requiring infrastructure proposals to fit predetermined categories rather than adapting support mechanisms to emerging needs. The seven-year MFF cycle particularly exemplifies this rigidity: grid investment priorities evolve continuously as electrification accelerates and bottlenecks emerge, yet funding envelopes are fixed years in advance. Needs that become urgent mid-cycle lack accessible resources, while the next cycle's allocation is negotiated based on projections that may be outdated before implementation begins. The Commission's proposed five-fold increase in CEF Energy budget to €29.91 billion for 2028-2034 represents a significant commitment, but its effectiveness depends on whether allocation mechanisms can adapt to the transformation's unpredictable trajectory.

The financing challenge reflects a governance deficit rather than a resource constraint. The question is not whether capital is available but whether institutional arrangements can mobilize it efficiently and equitably. Current financing governance suffers from the same conceptual impasse identified throughout this analysis: liberalization's institutional

architecture cannot execute the coordination functions that transformation demands, yet political systems resist acknowledging this failure. The result is a patchwork of hybrid mechanisms—regulated returns with political override, private capital with state guarantees, national ownership with European co-financing—that combines the weaknesses of public and private models while capturing the strengths of neither.

A coherent financing framework would require explicit political choices about risk allocation, temporal coordination, and distributional fairness. Should transformation risks be borne by infrastructure users through tariffs, by taxpayers through state financing, by investors through market exposure, or through some combination? Should financing favor accelerated deployment even at risk of overcapacity, or conservative investment accepting possible bottlenecks? Should costs be distributed progressively through general taxation or proportionally through user charges?

Until European governance confronts these choices directly—acknowledging that grid financing is not a technical problem requiring financial engineering but a political challenge requiring democratic legitimation—infrastructure investment will remain reactive, fragmented, and inadequate to transformation's scale and urgency.

7. Conclusions: Governance Challenges and Pathways Forward

Europe confronts an infrastructure transformation of unprecedented scale and urgency. The €1.2 trillion investment requirement by 2040 — €730 billion for distribution grids and €472 billion for transmission infrastructure — represents not merely a financial challenge but a fundamental test of governance capacity. The economic case is compelling: enhanced European market integration could generate annual cost savings of €40 billion. Boosting cross-border electricity trade by 50% could raise annual EU GDP growth by around €18 billion by 2030. Investing €5 billion in interconnection would reduce total system costs by €8 billion, creating a net economic gain of €3 billion.

Can Europe's institutional architecture execute the infrastructure transformation at the speed and scale that climate physics and geopolitical realities demand? What was originally conceived as an ecological transformation project has evolved into a strategic imperative, as the energy shocks of 2022 and beyond exposed the geopolitical vulnerabilities of fossil fuel dependency. The energy transition must now simultaneously serve climate ambitions, strategic autonomy, and industrial competitiveness — objectives that demand coherent coordination across all governance levels.

Before liberalization, vertically integrated utilities operated within corporatist frameworks where ministers coordinated industrial investment plans with grid expansion. Liberalization replaced this coordination with the belief that market signals alone would efficiently align supply and demand. Once markets had been liberalized, fixed outcomes were increasingly

imposed on free market platforms: emissions targets, renewable shares, and efficiency mandates. A liberalization paradox manifests when close to all recent generation capacity investments have been subsidized. More fundamentally, the energy transition requires strong coordination across competing design logics — geoeconomic, capitalist, ecological, and social-integrative — that manifest differently at European, national, and local levels. In European Commission communications, the geoeconomic logic prevails, but at the national level the capitalist logic clearly favors profitable grid investments over strategically necessary ones.

All decarbonization scenarios project substantial growth of electricity demand, yet demand has stagnated since 2018. This uncertainty creates asymmetric risks: underinvestment produces immediate economic damage while overinvestment risks stranded assets. A lower-than-expected electricity demand will significantly impact CfD costs, eventually entailing fiscal risks for countries like Germany. Meanwhile, grid modernization increasingly relies on 'behavioral infrastructure' — demand response, smart meters, and vehicle-to-grid integration — requiring diffuse participation across millions of households. Current policy treats flexibility as mere techno-economic optimization. Legitimate flexibility governance requires moving beyond market voluntarism toward explicit recognition of flexibility as a civic contribution to collective infrastructure, deserving fair compensation and reciprocal protections.

The Dutch congestion crisis exposes the consequences of uncoordinated policy at national level. Once grid operators establish priority lists for scarce grid capacity, they execute de facto industrial policy and shape economic and societal landscapes. Yet these profoundly political choices are made reactively by grid operators applying quasi-technical criteria, not proactively by governments articulating strategic visions. Liberalization sought to depoliticize infrastructure. The energy transition reintroduces precisely the political allocations liberalization aimed to avoid.

We are confronted with a structural mismatch between policy ambition and institutional capacity. Permitting duration does not reflect bureaucratic inefficiency but decades of accumulated societal preferences embedded in institutional logic. Europe needs a democratic theory of necessary infrastructure that can legitimate concentrated burdens in service of collective transformation, without abandoning the participatory norms that define liberal governance.

The financing challenge ultimately reflects a governance deficit rather than a resource constraint. Private grid operators are incentivized to minimize capital expenditure while the energy transition demands the opposite. The needed investments coincide with significant fiscal deterioration: EU public debt is projected to climb from 80.7% of GDP in 2024 to nearly 90% by 2026. Precisely when market coordination failures become undeniable, fiscal constraints prevent governments from reasserting directive roles. Germany's €500 billion special fund socializes costs across the tax base, prioritizing social-integrative and geoeconomic logics over full cost recovery through user charges. The multiplicity of EU financing instruments — CEF-E, Modernisation Fund, Cohesion Fund, ERDF, Innovation Fund

— exemplifies institutional fragmentation, while rigid seven-year MFF cycles cannot adapt to continuously evolving priorities.

Addressing these governance challenges requires fundamental institutional innovation across three domains. First, reconstruct coordination mechanisms between electricity supply and demand. Grid capacity allocation represents de facto industrial policy: governments must articulate strategic economic visions determining sectoral priorities, and cross-border coordination must evolve into binding mechanisms ensuring complementary national investments. Second, develop democratic theories of necessary and behavioral infrastructure. Benefit-sharing mechanisms must evolve from one-off compensation toward structural revenue-sharing. Flexibility provision must be recognized as a civic contribution to collective infrastructure deserving fair compensation reflecting system value created. Third, create adaptive financing frameworks that share transformation risks proportionally among states, consumers, and investors, replace rigid MFF cycles with adaptive mechanisms, and make explicit democratic choices about cost distribution.

Current governance suffers from a conceptual impasse: liberalization's institutional architecture cannot execute the coordination functions that transformation demands, yet political systems resist acknowledging this failure. With European coordination emerging as a precondition for transformation, the fundamental question is whether the era of market liberalization is giving way to a new era of system planning — and whether Europe's democratic institutions can design that transition before geopolitical and climate urgencies remove the choice entirely.

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