

Challenges and Perspectives in the Transmission Planning in Southeast Europe

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Abstract: Transmission planning in Bulgaria, Romania, Greece, Croatia and Slovenia has to absorb fast growth of renewables and storage, close regional price gaps and fit national plans into EU instruments that are being revised. This paper reviews the latest ten-year plans of the five transmission system operators and the related regulatory decisions, the ENTSO-E regional investment plan for Continental South East, the second Union list of projects of common and mutual interest and the European Grids Package, together with peer-reviewed studies. Three groups of challenges stand out. Connection requests exceed what the grids can host; the Bulgarian operator reports that signed contracts have exhausted transfer capacity in all regions. Cross-border projects slip or stall, and Greece remains far below the 15% interconnection target. Permitting, financing and equipment supply can stretch delivery beyond a decade. A framework is proposed that links four planning levels to these challenges and to indicators measured against EU benchmarks.

Keywords: transmission planning, interconnection, projects of common interest, renewable integration, Southeast Europe.

JEL: L94, Q41, Q48

I. INTRODUCTION

The ENTSO-E regional investment plan for Continental South East describes north–south flows, and the reverse, as one of the main transmission directions of the region, and lists bottlenecks such as the 220 kV grid near Dobruja and Varna (ENTSO-E, 2025). In summer 2024 these limits showed up in prices. The European Commission notes structural price differentials in the region, with average disparities of more than 10 EUR/MWh between countries, and concludes that infrastructure reinforcements are needed on most of its borders (European Commission, 2025).

Planning runs at three formal levels. Each transmission system operator (TSO) prepares a ten-year development plan for approval by the national regulator. ENTSO-E assembles the Union-wide Ten-Year Network Development Plan (TYNDP) and its regional investment plans. The Commission selects projects of common interest (PCIs) and, with third countries, projects of mutual interest (PMIs) under Regulation (EU) 2022/869. The EU Action Plan for Grids put grid investment needs at EUR 584 billion for this decade and reported permit waiting times of 8–10 years for high-voltage lines (European Commission, 2023). The European Grids Package of December 2025 raises the estimate to EUR 1.2 trillion by 2040 and announces a central EU scenario for planning (European Commission, 2025).

Research on transmission expansion has moved from single-system optimisation to regional planning under uncertainty (Lumbreras & Ramos, 2016). Studies of Southeast Europe, however, deal mostly with long-term scenarios, market coupling or single projects (Szabó et al., 2019; Makrygiorgou et al., 2020; Karystianos et al., 2021). This paper reads the current plans of the five EU members of the region, Bulgaria, Romania, Greece, Croatia and Slovenia, against the EU instruments. It groups the challenges the plans and regulators report and proposes a framework for following progress.

II. THEORETICAL FRAMEWORK

Lumbreras and Ramos (2016) name two changes that made transmission expansion planning harder and more important: the integration of renewables and planning at regional level. They classify modelling choices through European transmission plans. Gomes and Saraiva (2019) review more than 140 studies, from planning after market restructuring to planning for renewable and distributed markets, and point to gaps in tools for the latter. Grid and storage are partly substitutes: in the European model of Fürsch et al. (2013), restricting grid expansion leads to more investment in storage.

Cross-border lines raise a question of who benefits as well as what they cost. Konstantelos et al. (2017) found the costs and benefits of North Sea interconnection unevenly spread between countries and proposed an allocation mechanism as a starting point for negotiation. Puka and Szulecki (2014) explain slow interconnector building by financing, diverging interests, governance and political discourse; in the German–Polish case political and governance problems weighed more than economic ones. Buijs et al. (2011) listed public opposition, complex regulation and delayed or cancelled projects as the obstacles to European transmission investment, and argued that alternative technologies can shorten delays enough to justify their higher cost.

In the stakeholder views collected by Battaglini et al. (2012), inadequate regulatory frameworks and limited public acceptance ranked above technical or financial issues. Cohen et al. (2016) showed with EU-27 survey data that information on the long-term benefits of a line lowers the probability of strong local opposition by about 10–11%. Dynamic thermal rating, reviewed by Karimi et al. (2018), estimates the actual current-carrying capacity of overhead lines from real-time conditions and can add capacity while new lines wait for permits.

Szabó et al. (2019) modelled an electricity roadmap for Southeast Europe and argued that renewable integration should be built into national and regional planning.

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Makrygiorgou et al. (2020) obtained higher welfare and closer prices with flow-based capacity calculation than with available transfer capacities in a five-country case. Selei et al. (2026) traced the 2024 price divergence in Central and South-Eastern Europe to a small number of network elements and recommended stricter enforcement of minimum cross-zonal capacity and stronger incentives for internal grid reinforcement. National studies cover the Aegean island interconnections planned by the Greek operators (Karystianos et al., 2021), renewable integration in Croatia (Holjevac et al., 2021) and curtailment in Greece, where more than 200 GWh of renewable energy was curtailed in a single quarter of 2024 (Basoulou & Kosmopoulos, 2026).

III. METHODOLOGICAL FRAMEWORK

The study is a document review. It uses the latest ten-year plans of ESO, Transelectrica, IPTO, HOPS and ELES and the related regulatory decisions and company reports; documents of ENTSO-E, ACER and the European Commission; EU legal acts; and peer-reviewed papers checked against their DOI records. Documents were read up to 9 October 2026. Figures are reported only where a primary document states them, so investment totals appear only for Croatia.

The following research questions were defined:

RQ1: How do the national plans of the five TSOs relate to the EU planning instruments and to the cross-border needs identified by ENTSO-E?

RQ2: Which challenges do the plans, regulators and EU bodies report for the region?

RQ3: How can progress in transmission planning be followed so that the five systems can be compared?

RQ1 is answered in 4.1 with Table 1, RQ2 in 4.2 and RQ3 in 4.3.

IV. RESULTS

4.1. National plans and EU instruments

All five TSOs have a ten-year plan in force or in approval, but at different stages (Table 1). The Romanian regulator approved Transelectrica's 2026–2035 plan in September 2026. The plan contains 117 investment works, 25 of them new, and the regulator required an acceleration programme within 30 days for the unfinished works on the interconnections with Hungary and Bulgaria (ANRE, 2026). The Croatian regulator approved two scenarios of the HOPS 2026–2035 plan, revitalisation of the existing grid and the NECP 2030 scenario, and refused the rest (HERA, 2026a). Those two scenarios amount to about EUR 1.53 billion and EUR 255 million, against more than EUR 2.5 billion proposed by HOPS (HERA, 2026b). The Greek 2027–2036 programme was in public consultation in September–October 2026, while the regulator had asked IPTO for supplementary data on the 2025–2034 plan (IPTO, 2026a, 2026b).

Table 1: Ten-year plans, interconnection levels and reported constraints of the five TSOs, status on 9 October 2026.

TSO (country)	Plan, status	Interconn. level 2026	Reported constraint	Cross-border project, status
ESO (BG)	2026–2035	18.8%	signed contracts exhaust capacity in all regions	BG–RS Bobov Dol–Leskovac (PMI), end-2036
Transelectrica (RO)	2026–2035, approved 09/2026	15.7%	Dobrogea and Banat congested	RO–HU cluster (PCI), acceleration programme
IPTO (GR)	2027–2036, in consultation	6.1%	RES 18.4 GW to 36 GW by 2035	GR–CY Great Sea Interconnector (PCI), no full notice to proceed (03/2026)
HOPS (HR)	2026–2035, partly approved 04/2026	36.0%	7.3 GW requested, 1.6 GW contracted (02/2024)	GreenSwitch smart grid (PCI, AT–HR–SI)
ELES (SI)	2025–2034	74.8%	Beričev–Divča 400 kV suspended	Kozjak pumped storage (PCI)
Sources: ANRE (2026), ELES (2026), ESO (2026), European Commission (2026b), HERA (2026a), HOPS (2024), IPTO (2026a, 2026b), Transelectrica (2025), Commission Delegated Regulation (EU) 2026/764.				

The regional investment plan identifies 2030 capacity increases above 1,000 MW on the Hungary–Romania and Austria–Slovenia borders, among others, and up to 1,000 MW at the Bulgaria–Romania and Romania–Serbia borders by 2040. It finds no need at the Bulgaria–Greece border, where the Maritsa East–Nea Santa line entered operation in July 2023 (ENTSO-E, 2025; ESO, 2026), and concludes that the 2040 needs are largely covered by projects already in the TYNDP portfolio. The second Union list, published in April 2026, contains 235 projects, 113 of them in electricity, offshore and smart grids (European Commission, 2026a). For the five countries it includes the Hungary–Romania cluster, the Great Sea Interconnector through Crete to Cyprus, the GRITA 2 link to Italy, pumped storage in Bulgaria, Greece and Slovenia, and the smart grid projects CARMEN (BG–RO) and GreenSwitch (AT–HR–SI). The links to Egypt, Serbia, Georgia and Ukraine are PMIs (Commission Delegated Regulation (EU) 2026/764).

Against the 15% interconnection target for 2030 (Regulation (EU) 2018/1999, Art. 4(d)), four of the five systems are above the threshold in the Commission's 2026 figures, from 15.71% in Romania to 74.75% in Slovenia. Greece stands at 6.10% (European Commission, 2026b).

4.2. Challenges reported for the region

Connecting renewables and storage. Connection demand runs ahead of grid capacity in every plan reviewed. The Bulgarian plan for 2026–2035 counts 19,952 MW of new capacity to connect, 11,422 MW of it renewable, plus 7,610 MW of storage. It states that signed connection contracts have exhausted the transfer capacity of the existing grid in all regions and that ESO cannot build lines and substations at the pace at which renewable plants are built (ESO, 2026). In Croatia, 7,326 MW of connection requests stood against 1,604.2 MW of signed contracts in February

2024 (HOPS, 2024). Transelectrica reports that the Dobrogea and Banat regions are congested and no longer allow new capacity, with about 5,000 MW to be freed by 2027 (Transelectrica, 2025). IPTO expects installed renewables to grow from 18.4 GW to more than 28 GW in 2030 and 36 GW in 2035 (IPTO, 2026a).

Cross-border capacity and projects. Romania's regulator found that the minimum 70% cross-zonal capacity required by Regulation (EU) 2019/943 (Art. 16(8)) was not fully met at the borders with Hungary and Bulgaria (ANRE, 2026). ACER (2025) concluded that meeting the 70% rule would reduce price volatility and spikes such as those of summer 2024, and ACER (2026) found that planned network maintenance had further limited cross-border capacity. Flagship projects are behind schedule. On the Great Sea Interconnector, IPTO had not issued the full notice to proceed to the cable supplier by the time of its 2025 annual report, with the last payment in April 2025 and an estimated slippage of about a year from that notice (IPTO, 2026b). A second Bulgaria–Serbia line is expected only by the end of 2036, after the current plan period (ESO, 2026).

Permitting, financing and supply. Regulation (EU) 2022/869 (Art. 10) limits the permit-granting process for PCIs to 42 months, but HOPS states that preparation and construction often take more than ten years (HERA, 2026b). ELES suspended the conversion of the Beričevo–Divača line from 220 kV to 400 kV because of problems with integrating overhead lines in the environment (ELES, 2026). Transelectrica had carried out 29.3% of its 2025 investment programme by 30 June 2025 (Transelectrica, 2025). IPTO plans time for permits and expropriations and notes that global transport restrictions affect project execution, though it expects no significant delays (IPTO, 2026a).

4.3. Perspectives and an assessment framework

The EU instruments now under way address part of these problems. The Grids Package targets permit-granting of up to two years in most cases and three years for the most complex projects, and its South-East Europe energy highway targets the interconnection gaps of the region (European Commission, 2025). The Action Plan for Grids supports anticipatory investment (European Commission, 2023). ACER (2026) recommends faster deployment of grid-enhancing technologies, better regional coordination of outage planning and remedial actions, and accelerated investment in interconnection. At regional level, CESEC ministers endorsed on 27 October 2025 a revised electricity and renewable energy action plan aimed, among other things, at the price spikes in the region (European Commission, 2026c). Storage is part of the answer too: the Union list carries pumped-storage PCIs in three of the five countries.

Figure 1 links the four planning levels, EU, regional, national and project, to the three groups of challenges. Each cell names the issue observed in the region or the instrument that addresses it. Progress is followed with five indicators, each with an EU benchmark:

Planning level	C1 Connecting RES and storage	C2 Cross-border capacity	C3 Delivery: permits, finance, supply
EU	central EU scenario; anticipatory investment	PCI/PMI list; cross-border cost allocation	42-month permit limit; 2–3 year target (Grids Package)
Regional	CESEC electricity and RES action plan	ENTSO-E regional needs; 70% rule; flow-based coupling	coordinated outage planning during construction
National	requests exceed hosting capacity (BG, RO, HR)	internal elements limit cross-zonal trade	partial plan approval; connection charges; financing
Project	storage and dynamic line rating at congested nodes	Great Sea Interconnector, BG–RS line delayed	spatial plans, expropriation, equipment lead times

 issue observed in the region

 instrument or response (italic)

Figure 1: Planning levels, challenge groups and the issues or instruments observed in Southeast Europe.

11. Interconnection level against the 15% target of Regulation (EU) 2018/1999.

12. Share of hours in which each border meets the 70% minimum cross-zonal capacity.

13. Ratio of signed connection contracts to connection requests, as a measure of unmet demand for access.

14. Duration of permit granting for PCIs against the 42-month limit of Regulation (EU) 2022/869.

15. Share of plan investment carried out in the year against the share planned.

Each indicator is expressed as a normalised shortfall g_{ck} between 0, benchmark met, and 1, the largest shortfall, and the shortfalls are combined as:

$$G_c = \sum_{k=1}^5 w_k g_{ck}$$

where G_c is the planning gap of system c and w_k the weight of indicator k , with the weights summing to 1. For I1 the shortfall is $(15 - x_c)/15$ for levels below 15%, where x_c is the interconnection level. With the 2026 figures it is 0.59 for Greece and 0 for the other four systems. I2 and I4 need border- and project-level data that the sources reviewed do not publish for all five systems, and in the sources reviewed I3 can be filled only for Croatia and I5 only for Romania.

CONCLUSION

The five EU systems of Southeast Europe plan within the same EU framework, but their plans stand at different stages and meet the same limits. Requests to connect renewables and storage exceed what the grids can host in Bulgaria, Romania and Croatia. Cross-zonal capacity falls short of the 70% rule on Romanian borders. Greece remains the least interconnected of the five. Flagship links to Cyprus and Serbia have slipped, and one Slovenian upgrade is suspended. Permit-granting in practice takes far longer than

the 42 months set for PCIs. The Grids Package, the second Union list and the CESEC process give the region more instruments than it had in 2024, and the proposed indicators show where they would need to act first. Only the first indicator can be computed for all five systems from public sources today.

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