



MAPPING ERRA MEMBERS LANDSCAPE

Celebrating Diversity in Energy Regulation

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On the occasion of the 25th Anniversary of ERRA Foundation

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INTRODUCTORY NOTE

The Grouping System: Mapping Diversity, Not Ranking Progress

The analytical backbone of the ERRA Mapping exercise is a grouping system that enables a qualitative mapping of ERRA member regulators across several regulatory areas, grounded in facts and data.¹

A preliminary clarification is essential to reading this system correctly: the grouping levels are intended to be a descriptive instrument, not a normative ranking. They are designed to map the landscape of regulatory diversity across a membership whose geographic, economic, and institutional range is genuinely extraordinary – spanning the EU single energy market, transition economies of the Western Balkans and the Caucasus, Gulf regulators operating in state-led energy systems, Central Asian markets in various phases of reform, and very diverse regulatory frameworks from Africa to Southeast Asia and even to the Caribbean.

ERRA's multiregional dimension is not the product of historical contingency, but rather a distinctive institutional asset. No other association in the global regulatory community brings together regulators from such diverse contexts in a structured dialogue. In line with this ambition, the grouping system does not evaluate members against a single reference model; rather, it situates each jurisdiction within a multidimensional landscape in which different configurations may represent legitimate and effective responses to local conditions.

In practice, this means that a regulator scoring Group 2 in a given Area (say, on household price liberalization) is not assessed as "behind" a Group 4 Member (for the same Area) – it may pursue a deliberate, coherent policy adapted to its social and fiscal context. Similarly, a single-sector energy regulator scoring Group 0 on multisectoral scope (meaning: it regulates only electricity or only gas) is not structurally weaker than a multi-sector authority: as the analysis in Chapter 1 demonstrates empirically, independence and scope are uncorrelated. The grouping levels enable comparison and conversation – the peer-learning dimension that is the heart of ERRA's mission – without imposing a single institutional trajectory as the only valid destination.

This spirit of "diversity as richness" is the interpretive key for all that follows.

¹ The original idea springs from a similar staged classification proposed by IEA for variable renewable energy (VRE) impact on power system (International Energy Agency, *Status of Power System Transformation, System Integration and Local Grids* IEA Report 2017), in particular Ch.3 and Table 3.1: www.iea.org/reports/status-of-power-system-transformation-2017

EXECUTIVE SUMMARY

CH.1 | REGULATORY INDEPENDENCE & MULTISECTORAL JURISDICTION

The ERRA mapping exercise reveals a mature and diverse regulatory landscape across the association's surveyed member jurisdictions. Two striking patterns emerge from this preliminary analysis of Areas A (regulatory independence) and B (multisectoral jurisdiction) of the Mapping exercise: first, a remarkable concentration of regulatory independence at the highest levels, and second, the complete absence of impact of the width of regulatory scope (as a variety of regulated sectors) on the level of institutional autonomy.

In Area A (Regulatory Independence), 21 of 37 respondent members – 57% of the ERRA membership—have achieved the highest level of formal independence according to the original “grouping system” elaborated by ERRA (Group 4), characterized by full autonomous decision-making powers and a robust institutional profile of formal independence. This concentration challenges conventional narratives about regulatory development in emerging markets and transition economies. When combined with the 14 members in Group 3 (intermediate-high independence), **fully 95% of ERRA surveyed regulatory members have achieved substantial regulatory autonomy in core functions.**

In Area B (Multisectoral Jurisdiction), **ERRA members display extraordinary diversity in their regulatory scope.** While electricity coverage is nearly universal (37 of 38 surveyed members), and energy regulation in most cases includes gas and sometimes district heating as well, **the inclusion of gas, indeed the inclusion of different sectors under the same regulatory jurisdiction, varies significantly.** Some regulators, like Hungarian MEKH, Lithuanian NERC, Latvian PUC, Polish URE, Turkish EMRA and few others, oversee several and very diverse sectors (more than 2 sectors among energy, water, district heating, telecommunications and postal services); more than half of the total (21 out of 38) focus exclusively on energy markets (electricity and gas, sometime covering also district heating/cooling) and, of those, in 5 cases only one energy sector (either only electricity or, in a single case, only gas, although partially combined with hydrogen: Egypt GASREG).

The lack of relationship between regulatory independence (as measured by the formal independence total index) and sectoral scope regulation and enforcement is perhaps the most assertive finding: regulatory independence and multisector jurisdiction are virtually totally uncorrelated with each other. This suggests they are driven by fundamentally different policy considerations: governance philosophy shapes independence, while administrative efficiency and sectoral synergies determine scope.

The implication is profound: ERRA's diversity is not a weakness to overcome but a richness to celebrate, reflecting different institutional solutions to common regulatory challenges.

CH.2 | CUSTOMER PROTECTION & HOUSEHOLD REGIMES FOR ELECTRICITY PRICES

In the second chapter of the ERRA mapping exercise, we take the perspective of final customers. Customer protection is at the heart of the original birth of independent regulation, as well as setting electricity tariffs at least within vertically integrated, monopolistic environments. Of course, after many years, both functions evolved, along with the progressive introduction of competition in power systems (and gas as well).

Area C (Customer Protection) examines how regulators protect end-users through quality standards, complaint handling, compensation mechanisms, vulnerable customer regimes, and alternative dispute resolution (ADR). Area D (Household Electricity Price Regimes) maps the degree to which household electricity prices are set by the market or by regulatory intervention, and the nature of any residual subsidies. Area E looks at the possible liberalization of the retail market.

Two main findings stand out. First, **customer protection capacity is remarkably advanced across ERRA membership: 81,5% of surveyed members (31 out of 38) fall in Groups 3 or 4**, indicating substantial or full consumer protection frameworks. Most regulators have established quality standards and compensation regimes, while ADR with regulatory involvement is also fairly widespread, including in some Group 2 jurisdictions such as Poland.

Second, **household electricity price regimes show substantially more variation, reflecting fundamentally different reform trajectories**. Six members operate fully liberalized retail markets with only residual Supplier of Last Resort regimes (Group 4); Seven retain Universal Service Supplier frameworks with cost-reflective regulated prices (Group 3); twelve maintain regulated prices that are broadly cost-reflective but still feature cross-subsidies among consumer groups, typically through block consumption tariff (Group 2); nine apply regulated prices with significant subsidies to all or most households (Group 1); and two remains at Group 0 with metering gaps that preclude consumption-based billing.

The two areas are not unrelated: jurisdictions at higher levels of market liberalization (Groups 3–4 in Area D) tend also to have more developed customer protection frameworks (Groups 3–4 in Area C). However, the correlation is far from perfect because several Group 2 members in Area D maintain robust customer protection structures – confirming that consumer advocacy and market liberalization represent distinct policy dimensions.

CH.3 | UNBUNDLING, WHOLESALE ELECTRICITY MARKETS AND REGIONAL INTEGRATION

In this third chapter of the ERRA mapping exercise, we examine **three closely related dimensions of electricity market architecture**: the structural separation of grid operators from commercial activities (Area F: Unbundling), the development of competitive wholesale electricity markets at the national level (Area G), and the integration of those markets into broader regional pools and interconnected systems (Area H: Regional Markets). Together, these three areas map the value chain from infrastructure governance to the trading arrangements that determine how electricity is priced and allocated across ERRA's diverse membership. Several main findings stand out.

First, ERRA members display a pronounced structural bifurcation: **a large group has completed the full arc from ownership unbundling through competitive wholesale markets to regional integration** – mostly EU and other European countries but non-EU members – while a second group –

concentrated in Africa, Central Asia, and parts of the Middle East – operates vertically integrated or only partly reformed systems where network separation remains incomplete and market-based procurement is limited or absent. Between these two poles, a middle tier of eleven members in hybrid market positions represents the most dynamic part of the survey: these are regulators actively navigating the transition from inherited state-owned structures toward more competitive arrangements, each following a distinct pathway conditioned by geography, system size, and political economy.

Second, **the three areas form a logical developmental sequence that the data validate empirically**: with only rare exceptions, strong performance on Area G (wholesale markets) presupposes at least Group 3 on Area F (unbundling), and strong performance on Area H (regional integration) tracks Group 3 and 4 on Area G. Structural separation of transmission network operator (TSO) is not merely a regulatory formality – it is the institutional precondition for network access neutrality and therefore for competitive market development. The few cases that deviate from this sequence – most notably Cameroon, which achieves Group 4 on unbundling while occupying Group 2 on wholesale market development – are analytically revealing: they demonstrate that institutional reform can outpace market development, and that structural separation, however well-designed, does not automatically generate a functioning market.

Third, and **perhaps most consequentially for ERRA as an association: the diversity documented here reflects genuinely different policy contexts rather than uniform progress along a single pathway**. A member regulating a small island system like the Bahamas, a vertically integrated Gulf utility, or a post-Soviet hybrid market in Central Asia faces structural constraints that make direct comparison with EU-integrated markets uninformative.

The chapter presents this diversity for what it is – a map of where ERRA members actually stand – rather than as a ranking of proximity to a single institutional ideal.

CH.4 | ELECTRICITY NETWORKS: INCENTIVE REGULATION AND TARIFF STRUCTURE

Chapter 4 addresses **two closely related regulatory areas that together define the quality and cost-efficiency framework for electricity network operators**: Area I – Regulatory Incentives to Grid Operators and Area J – Electricity Network Tariff Structure. Both areas sit at the heart of network regulation’s aim: how to create efficient incentives for natural monopolies that cannot be disciplined by competitive markets, and how to ensure that the costs of maintaining the network are recovered in a way that is both economically efficient and fair to consumers.

The two areas are presented in a deliberate order: Area I first, because the quality of incentive regulation directly determines whether the operator has reasons to minimise costs and improve service – the precondition for a well-functioning network. Area J then examines how the costs of that network are allocated among users through the tariff structure, with a focus on the degree to which the tariff has been adapted to the realities of the energy transition.

On incentive regulation (Area I), the dominant picture across ERRA’s membership is a well-established but essentially quality-centred model: 28 of 36 surveyed members (78%) fall in Group 2 or higher, having adopted price-cap or similar mechanisms on operating costs with at least service-quality incentives – primarily SAIDI and SAIFI – for electricity distribution. This represents a functional baseline of incentive regulation that has diffused widely across very different institutional and economic contexts. Of these 28, 8 members (26%, Group 3), adding capex incentives and output

indicators beyond service continuity, and 3 members (9%, Group 4), with Totex regulation, reflect the expanding definition of what regulators ask networks to deliver in the energy transition.

On network tariff structure (Area J), the picture is strikingly different – and more constrained. Most ERRA members (16 of 36, 44%) remain in Group 1, with a fully volumetric network tariff that recovers network costs entirely through energy consumed. This design made sense when electricity systems were built around a simple logic of more consumption yielding more revenue – but it becomes progressively misaligned with a world of energy efficiency, distributed generation and prosumers. A growing minority has moved toward mixed tariff structures (Groups 2 and 3 together: 15 members), and only two members – Greece (RAAEY) and Latvia (PUC) – have adopted tariff structures where the fixed or capacity component exceeds 50% of the bill at average household consumption (Group 4). **The strong concentration in Groups 1 and 2 highlights tariff structure as the area with the most significant reform agenda ahead for the majority of ERRA members.**

CH.5 | RENEWABLES, DIGITALIZATION AND ELECTRIFICATION OF THE POWER SYSTEM

The three regulatory areas examined in this chapter mark a structural threshold in the ERRA Mapping exercise. While earlier chapters addressed the institutional architecture of regulation, the terms of consumer engagement and pricing, and the design of networks and wholesale markets, this chapter turns to the technological transformation underway in ERRA member systems. **Renewable energy integration, smart metering deployment, and electro-mobility developments are not independent phenomena: they form an interrelated triad that is reshaping the operational and regulatory environment across the ERRA community.**

The expansion of variable renewable energy (VRE) generation creates new demands for operational flexibility and system balancing; **smart meters are the enabling infrastructure that makes demand-side flexibility visible and actionable;** and **electric vehicles, as both flexible loads and potential distributed storage assets,** represent one of the most consequential new electricity demand categories regulators must accommodate. Understanding the stage reached by each ERRA member in each of these dimensions is, therefore, essential context for any assessment of regulatory adequacy in the years ahead.

The diversity documented here – from systems where renewable penetration remains negligible to those where variable generation already determines dispatch patterns, from jurisdictions with near-universal smart metering to those still deploying first-generation meters – reflects both the extraordinary width of the ERRA membership and **the breadth of peer-learning it enables.**

CHAPTER 1 | REGULATORY INDEPENDENCE AND MULTISECTORAL JURISDICTION

AREA A: REGULATORY INDEPENDENCE

THE LANDSCAPE OF REGULATORY INDEPENDENCE

The distribution of ERRA members across the four groups reveals a regulatory landscape far more mature than often assumed. The grouping system classifies members from Group 1 (regulators with limited decision-making powers) to Group 4 (full independence with a strong formal profile), using both functional autonomy—particularly in network tariff regulation—and institutional safeguards, as measured by the formal independence profile (see below for methodological issues).

GROUP	A. Regulatory independence	N. of ERRA members	ISO country codes
0	The member is not a regulatory authority (e.g. energy agency or association of authorities)	0	—
1	Regulatory authority with limited decision powers (mainly advisory; proposals to government)	1	AE (Dubai)
2	Regulatory authority with partial independent powers (mainly network tariffs)	1	AZ
3	Regulatory authority with independent powers in core areas but intermediate formal independence profile	14	PL, CZ, TR, KG, LT, CM, UZ, EE, KZ, DZ, SK, SA, EG, OM
4	Regulatory authority with fully independent decision powers and strong formal independence profile	21	GR, GE, BA, PK, FR, TH, HR, AT, AL, MD, MZ, MK, HU, AM, MN, XK, RO, BS, LV, UA, BG
Total		37	

TABLE 1: Grouping System, distribution for Area A: regulatory independence (N=37; Nigeria N/A)

The concentration in the two higher levels (Groups 3 and 4) is striking. Twenty-one of the 37 ERRA-surveyed members have achieved full independence with robust formal protections – long, non-renewable or only-once renewable mandates, complex appointment procedures, dismissal only for cause, and financial autonomy. Among them are regulators with very different institutional shapes: ranging from a few cases featuring a single chairperson appointed by the government collectively, to most classical boards, whose members and Chair appointments employ a multi-stage selection process with cabinet approval, sometime a parliamentary scrutiny and in some cases final appointment by the State Chief (President of Republic or King, like in Thailand), to ensure political insulation. In some cases, the appointment of board members is pre-announced to stakeholders (as in Egypt and other countries). It must be distinguished between the Office and the Board: an interesting case under this respect is the Slovak ÚRSO (see box n.1).

Box n.1 | Slovak ÚRSO difference between the Office and the Board

The Office is composed of the Chairperson and two Vice-Chairpersons. The Vice-Chairpersons of the Office are appointed and dismissed by the Government upon the proposal of the Chairperson. The Office prepares the acts that the Board considers for approval or modification. The Board is composed of the Chairperson and 5 members. A rotation principle applies, whereby the President of the Slovak Republic appoints members of the Regulatory Board upon the proposal of the National Council of the Slovak Republic (NR SR) in such a way that three members of the Board are appointed on the proposal of the NR SR and three members on the proposal of the Government. One-third of the Board is renewed every two years. For each Regulatory Board seat, two candidates are proposed.

Fourteen members occupy Group 3, which possesses independent tariff-setting authority and customer protection powers but has somewhat weaker formal independence profiles. The single Group 2 member has autonomous powers primarily in network tariff matters, while the Group 1 member is mainly limited to advisory functions.

UNDERSTANDING THE FORMAL INDEPENDENCE PROFILE INDEX

METHODOLOGICAL NOTE ²

The Gilardi Index provides a systematic framework for measuring formal regulatory independence, originally developed for European regulatory agencies and adapted by ERRA in its 2015 independence survey.³

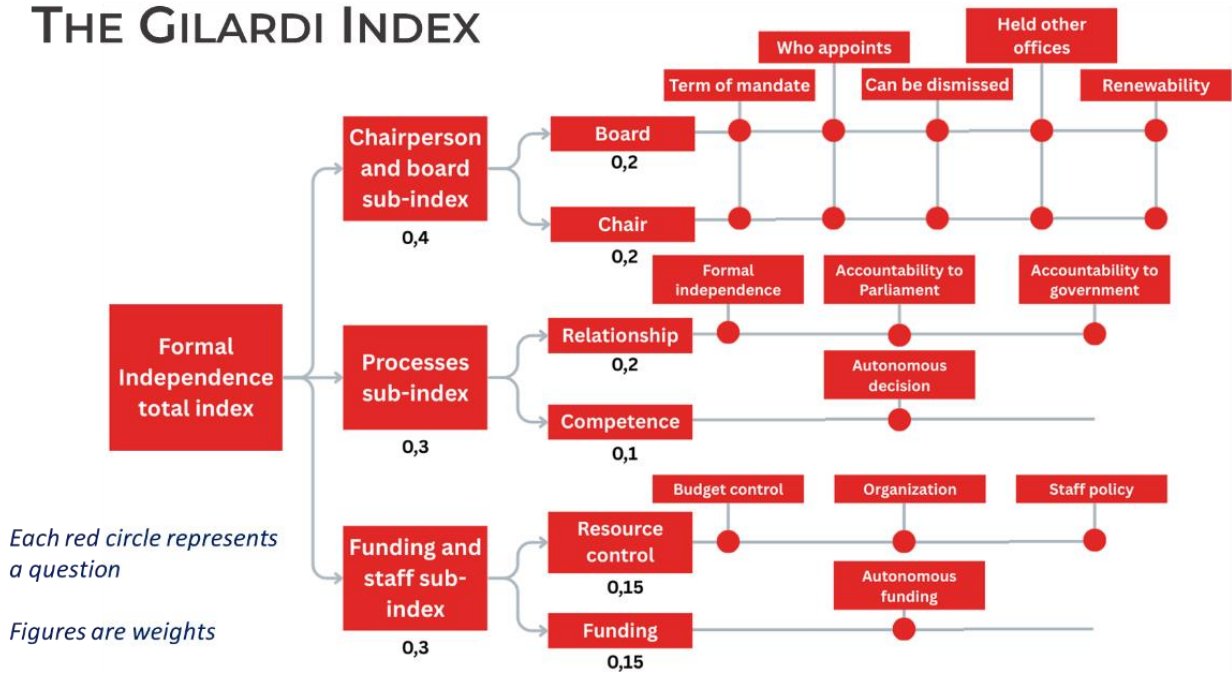
The index aggregates three sub-indices with differential weighting:

- **Chair & Board sub-index (weight: 40%): Appointment process, term length, dismissal protections, renewability conditions, and restrictions on holding other offices:** split into two sub-groups of 5 questions each, for Chair (weight: 20%; each question 4%) and for other commissioners of the Board (weight: 20%; each question 4%);
- **Processes sub-index (weight: 30%): Formal independence declarations, relationship with government/parliament, and autonomous decision-making competence:** split into two sub-groups, for relationships (weight 20%, 3 questions each weighting 6.66%) and autonomous decision-making (weight 10%, 1 question);
- **Funding & Staff sub-index (weight: 30%): Budget control, organizational autonomy, and staff policy independence:** split into two sub-groups, for autonomous funding (weight 15%, 1 question) and organization and staff policy control (weight 15%, 3 questions each weighting 5%).

² The formal independence profile index used is the Gilardi index as described in this section. There are also other regulatory indexes, for instance from OECD and the results are similar; for instance, within the OECD "Governance of Sector Regulators" (GSR) framework, the component for independence has an average value of 4.42 in a scale from 1 to 6, ranging from 2.94 min to 5.56 max (range 2.63); but in the OECD GSR framework the legal status and accountability correspond to different components, whilst Gilardi index is an integrated one (source: *The 2023 Indicators on the Governance of Sector Regulators*, OECD 2025).

³ ERRA, *ERRA Survey: Independence of the National Regulatory Authorities*, 2015. A few changes have been made as for weights, in order to give more relevance to autonomous funding and decision making.

THE GILARDI INDEX



GRAPH 1: Gilardi Index Structure showing three sub-indices and their components

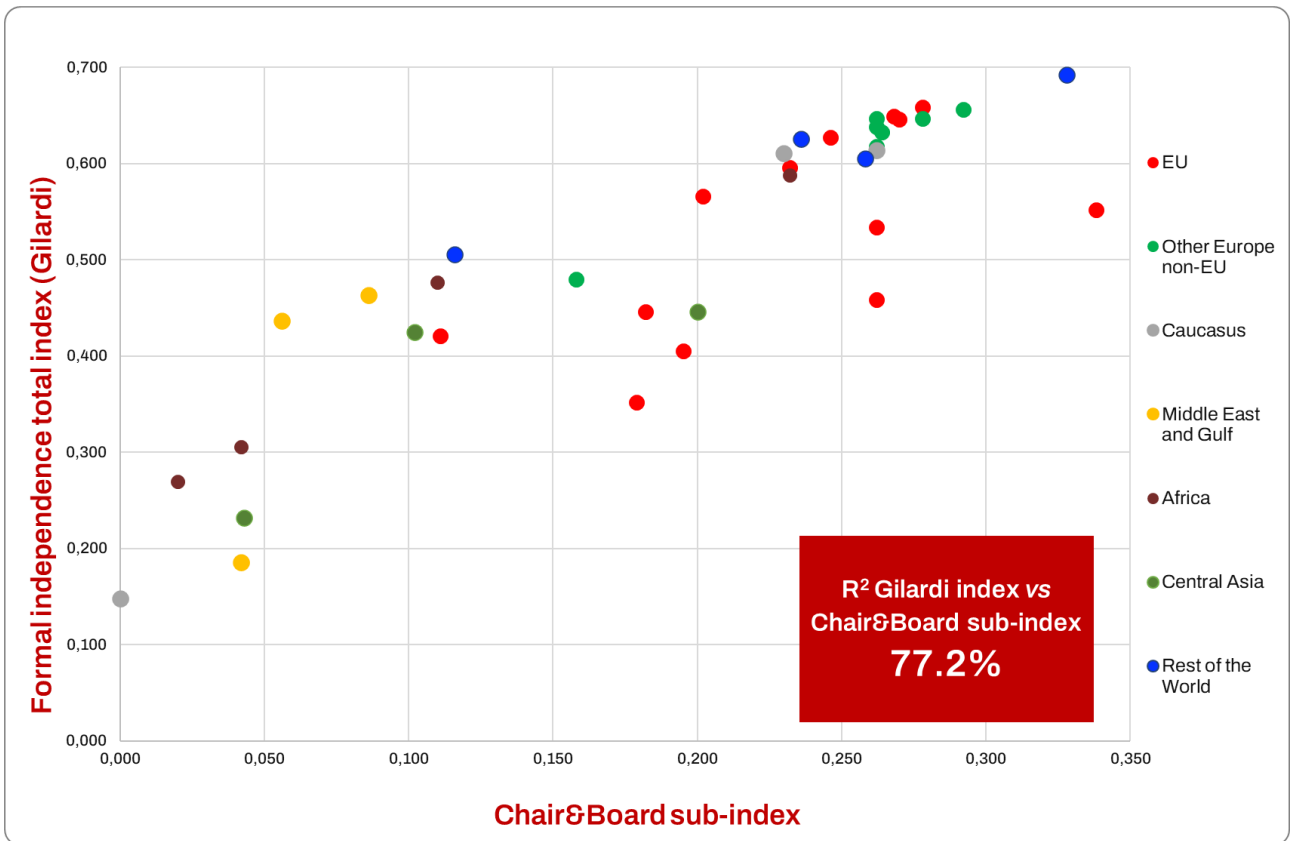
The composite index ranges from 0 to 1, with higher scores indicating stronger formal independence. For the ERRA mapping, a conventional threshold of 0.500 distinguishes between Group 3 (intermediate-high independence) and Group 4 (full independence), reflecting the point at which formal safeguards become sufficiently robust to support fully autonomous operation.⁴

THE KEY DRIVER: LEADERSHIP APPOINTMENTS

When we examine which components of the Gilardi Index most strongly predict overall independence, a clear hierarchy emerges. The Chair & Board sub-index exhibits by far the strongest correlation with total independence scores ($R^2 = 77.21\%$)⁵, while funding autonomy and procedural independence show less intense but nonetheless relevant correlations, comparable to each other ($R^2 = 44.51\%$ and 45.47% respectively).

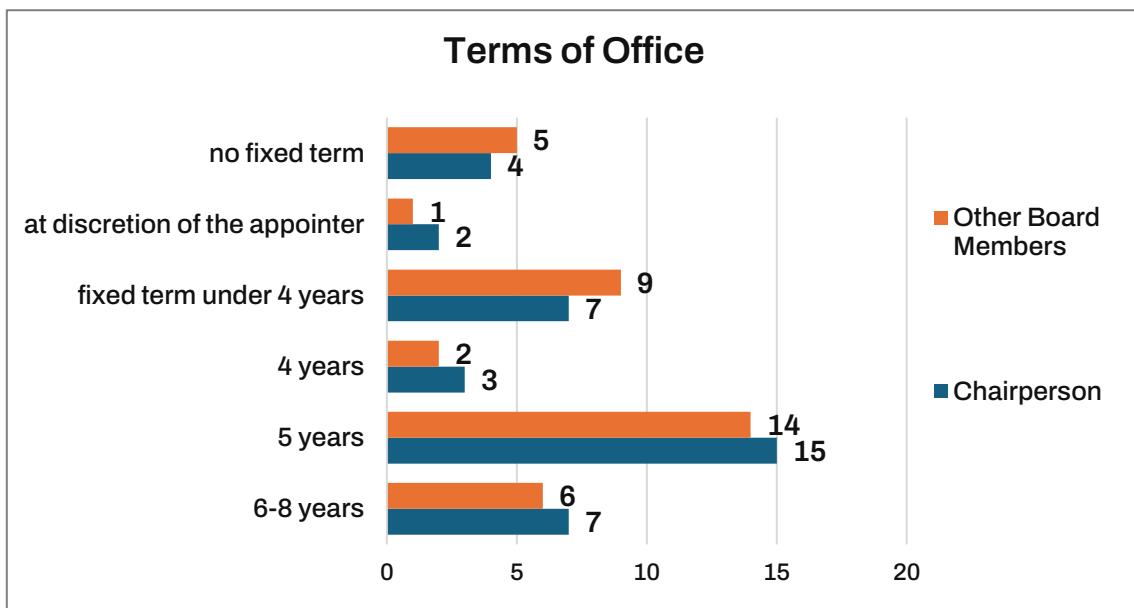
⁴ The average level of Gilardi index measured among surveyed ERRA regulators is extremely close to 0.500 (N=37, avg = 0.507).

⁵ R^2 is the Pearson coefficient of correlation between two variables (Y, dependent variable; and X, independent variable) and provides the percentage of variance of the dependent variable explained by the variance of the independent variable.

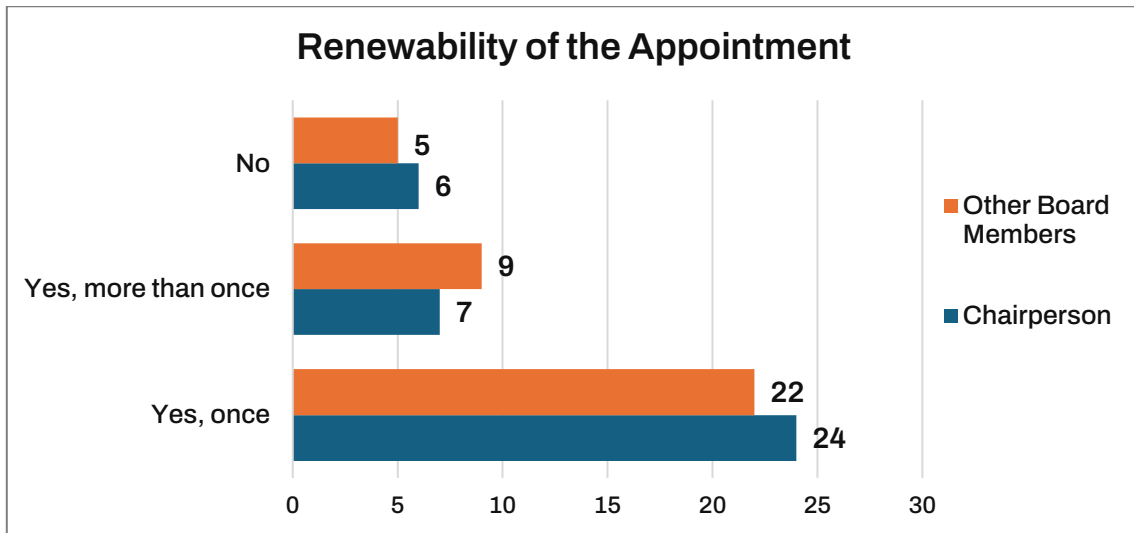


GRAPH 2: Scatter plot of Chair & Board sub-index vs. Gilardi Index total

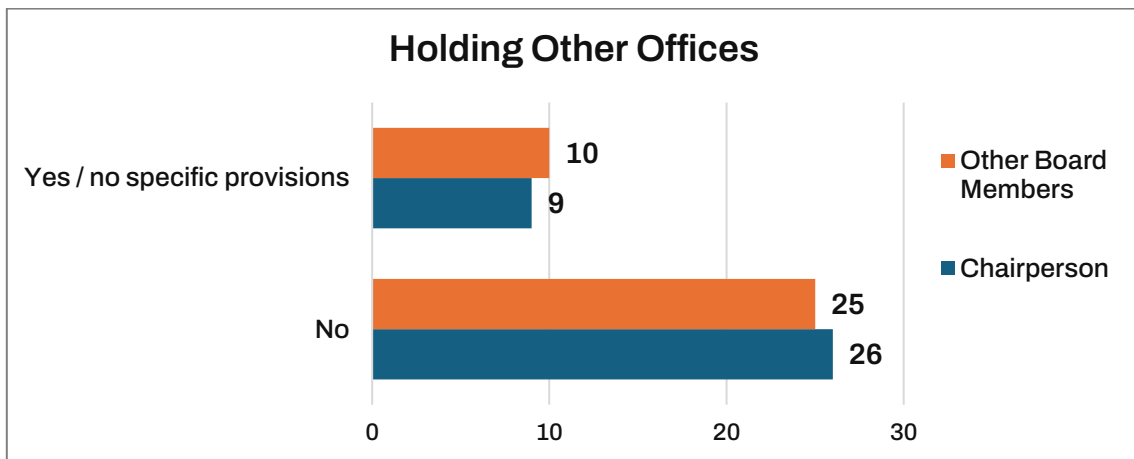
This finding has profound strategic implications. Leadership appointment mechanisms—not budgetary autonomy or procedural formalities – form the core of regulatory independence. The protection of board members and chairpersons from political pressure through long fixed terms, carefully designed reappointment rules, clear dismissal criteria, and prohibitions on holding other offices provides the institutional foundation for autonomous decision-making.



GRAPH 3: Number of regulators per length of the terms of office



GRAPH 4: Number of regulators per renewability of the mandate



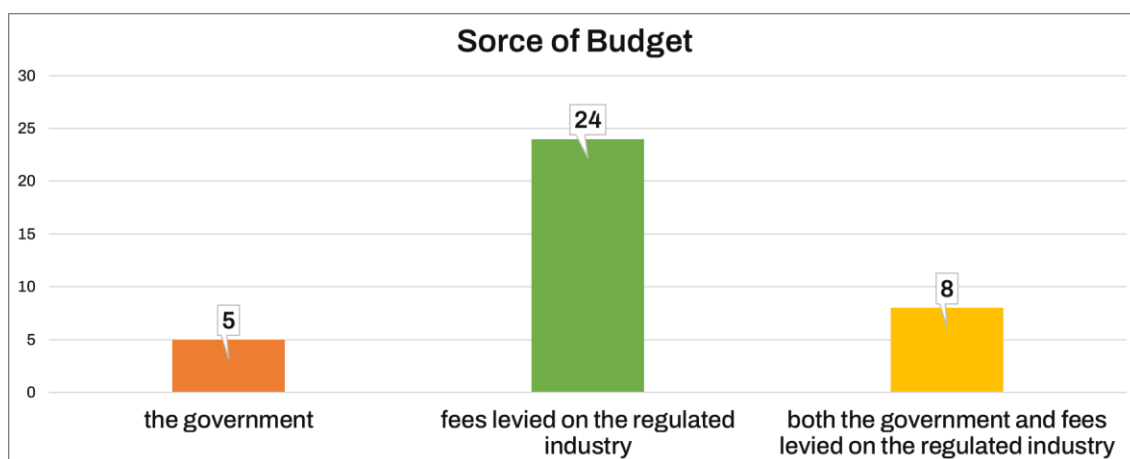
GRAPH 5: Number of regulators per right of holding other offices during the mandate

The charts above provide an aggregate picture of how certain elements of independence are distributed among ERRA regulators. What is most important, however, is their combination. Consider two ERRA members: the Czech Republic’s ERU and the Polish URE. Both achieve intermediate Gilardi scores, close to average, although not among the highest, due to other factors, among which is funding autonomy, that could be improved for both if consumer fees and levies were directed to the regulator’s budget without passing through the state budget as an intermediate step, a model that would eliminate the scope for political influence inherent in annual budget negotiations. What’s interesting here, however, is that close levels of the index correspond to different combinations of institutional design— the Polish Office is a single-person body, that can be assisted by a Deputy, while the Czech regulator is a board; in Poland, the appointment is by the Prime Minister, in Czech Republic by the Government collectively; term of mandate is different as well as renewability.

FINANCIAL AUTONOMY AND PROCEDURAL INDEPENDENCE

While leadership appointment protections dominate the independence landscape, financial and procedural dimensions still matter but are less relevant, given their statistical correlation with the overall formal independence profile.⁶

Financial autonomy takes various forms across ERRA members. The majority of surveyed ERRA regulators, particularly in the EU, enjoy complete budgetary independence, self-financed through regulatory fees. Others operate under government-approved budgets but with multi-year funding guarantees that limit short-term political pressure. The key distinction is not the funding source *per se*, but whether financial arrangements can be manipulated to influence regulatory decisions.



GRAPH 6: Number of regulators per ways of funding

Procedural independence—formal declarations of autonomy, the nature of accountability relationships with government and parliament, and the scope of decision-making competence—provides the legal architecture within which regulators operate. Regulators with strong procedural independence issue binding decisions without ministerial approval, maintain accountability through transparent reporting rather than prior authorization, and possess clearly defined competences that limit governmental discretion.

The relatively modest correlation of these dimensions with overall independence reveals an important insight: even regulators with government-influenced budgets or complex accountability structures can achieve substantial autonomy if their leadership is protected. Conversely, formal declarations of independence mean little without secure tenure for regulatory leadership. This explains why ERRA includes members with high independence scores, despite operating in contexts in which complete financial or procedural autonomy remains politically challenging.

GEOGRAPHIC DISTRIBUTION

The geographic distribution of independence scores defies simplistic regional categorizations. **High independence is not the exclusive province of EU members or high-income economies.** The highest-scoring regulators include members from the Caucasus, Central Asia, and Southeast Europe

⁶ The moderate correlations of funding autonomy ($R^2 = 44.51\%$) and procedural independence ($R^2 = 45.47\%$) with overall Gilardi scores suggest these dimensions can strengthen or weaken an otherwise robust independence profile.

alongside Western European authorities. This diversity reflects ERRA’s fundamental strength: the association’s value lies not in promoting a single institutional model but in facilitating peer learning across different contexts—recognizing that strong regulatory independence can emerge through various institutional pathways adapted to national political and administrative traditions.

Region	No. of regulators	Groups 1-2 (n.)	Group 3 (n.)	Group 4 (n.)	Average Index	Min-Max Index
EU	13	0	5	8	0.510	0.352 – 0.659
Other Europe non-EU	7	0	1	6	0.628	0.547 – 0.656
Caucasus	3	1	0	2	0.458	0.148 – 0.611
Middle East and Gulf	3	1	2	0	0.312	0.186 – 0.437
Africa	4	0	3	1	0.360	0.270 – 0.588
Central Asia	3	0	3	0	0.371	0.232 – 0.446
Rest of the World	4	0	0	4	0.607	0.506 – 0.692
TOTAL	37	2	14	21	0,509	0.148 – 0.659

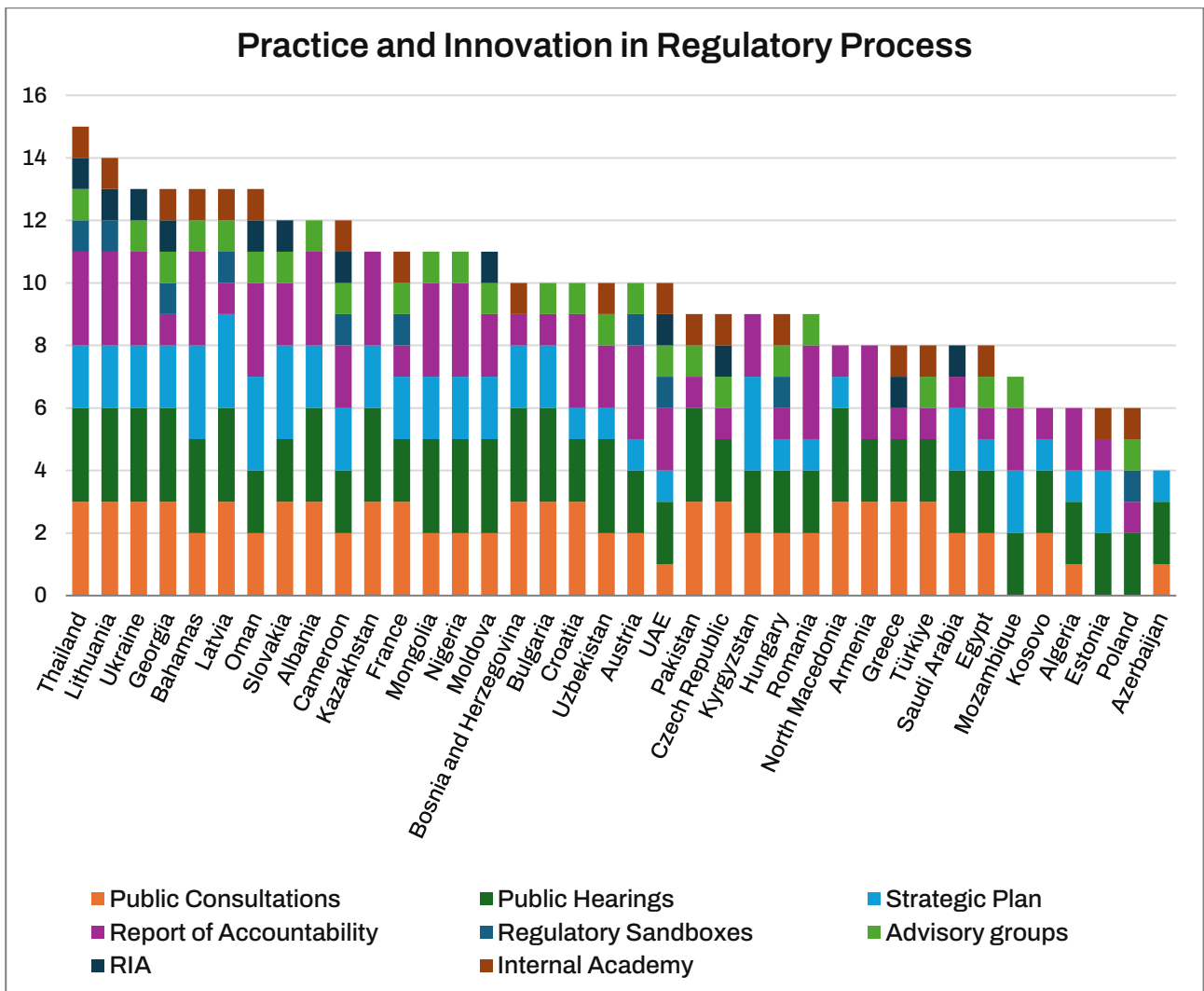
TABLE 2: Number of regulators per region and per group, average, min and max levels of Gilardi index⁷ (N=37, Nigeria N/A)

PRACTICE AND INNOVATION OF REGULATORY PROCESS

The topic of independence is strictly related to the regulatory decision-making process. Regulatory independence cannot be understood solely through formal institutional safeguards—the architecture of appointment procedures, term protections, and financial autonomy. While these structural elements provide the foundation, the legitimacy and practical sustainability of regulatory autonomy rest equally on how regulators engage with stakeholders, structure decision-making processes, and maintain public accountability.

The practice of regulatory process – captured through five dimensions in Graph 7 of the mapping exercise – reveals how ERRA members operationalize their independence. The composite "openness index" assigns weights of up to three points per dimension based on the intensity and formality of engagement: (1) public consultations before issuing regulations; (2) public hearings on major decisions; (3) strategic planning processes; (4) accountability reporting; and (5) innovative participation mechanisms including Regulatory Impact Analysis (RIA), (6) advisory groups with consumer representation, (7) internal academies for knowledge sharing, and (8) regulatory sandboxes for experimentation.

⁷ Regions are defined as follows: **EU (European Union)**: Austria, Bulgaria, Croatia, Czech Republic, Estonia, France, Greece, Hungary, Latvia, Lithuania, Poland, Romania, and Slovakia; **Other Europe non-EU**: Albania, Bosnia and Herzegovina, Kosovo*, Moldova, North Macedonia, Türkiye, and Ukraine; **Caucasus**: Armenia, Azerbaijan, and Georgia; **Middle East and Gulf**: Oman, Saudi Arabia, and UAE/Dubai; **Africa**: Algeria, Cameroon, Egypt, Mozambique, and Nigeria; Central Asia: Kazakhstan, Kyrgyzstan, and Uzbekistan; **Rest of the World**: Bahamas, Mongolia, Pakistan, and Thailand.



GRAPH 7: Frequency of most relevant practices and innovations in the regulatory process⁸

Consider the spectrum of practice across ERRA members. High openness is evidenced by public consultations on every regulatory decision, regular public hearings on major normative acts, a published strategic plan, a separate accountability report, and advisory groups, including consumer associations.

This comprehensive stakeholder engagement framework insulates regulators from short-term political pressure by creating procedural expectations and public scrutiny that would make capture evident. These practices, shared by many ERRA regulators although in different ways and mixes,

⁸ This composite indicator serves as a broad proxy for the procedural quality of regulatory practice rather than a narrow measure of openness alone. It aggregates eight components: public consultations, public hearings, strategic plan, report of accountability, regulatory sandboxes, advisory groups, regulatory impact assessment (RIA), and internal academy. For the first four components, scores are assigned according to the coding legend, depending on the substance of the reported practice, with a maximum of 3 points per indicator; for instance, consultation on every regulatory decision scores 3, while the absence of consultation scores 0. The remaining four components are scored on a binary basis, with 1 indicating presence and 0 absence. The resulting total score ranges from 0 to 16. The composite should be read as an indicative benchmarking tool rather than a precise measure of a single concept, as its components capture different dimensions of procedural transparency, capacity, and innovation.

reflect not bureaucratic formalism but a deliberate strategy to build regulatory legitimacy through procedural rigour and inclusive deliberation.

Box n.2 | **Oman APSR – Strategic Plan**

Oman's Authority for Public Services Regulation advances openness in its strategic planning through structured engagement. In practice, the Authority consults with the government and solicits proposed annual plans from regulated companies, using these inputs to inform and shape the Authority's proposed plan for the upcoming year.

This consultative process ensures that operational plans and local service considerations are incorporated in the upcoming plan. In addition, transparency is reinforced through a legal disclosure obligation: Clause 34 of the Law for the Regulation and Privatisation of the Electricity and Related Water Sector requires the Authority to disclose its plan prior to the forthcoming financial year, a requirement fulfilled by publishing the plan within its annual report.

Box n.3 | **ARSEL Cameroon – Strategic Planning and Accountability in Practice**

The Electricity Sector Regulatory Agency of Cameroon (ARSEL) offers an instructive example of how a regulator operating in a challenging institutional environment can invest systematically in transparency and accountability practices. ARSEL's Strategic Performance Plan 2024–2028 (PSP, publicly available on its website <https://arsel-cm.org>) sets out five strategic axes, each with measurable objectives, performance indicators, baselines and cost estimates – a level of planning detail and methodological rigour that is itself worthy of acknowledgement.

The PSP itself underwent validation by technical and financial oversight bodies before publication – an institutionalised form of external scrutiny. Notably, the PSP includes a frank public SWOT (Strength – Weakness – Opportunity – Threats) analysis across all regulatory components, consistent with ARSEL's own motto: "*transparence pour un secteur électrique performant*". Further, ARSEL maintains a Consumer Consultative Committee bringing together consumer associations, and invested in a dedicated digital platform (named eLECTRA), accessible online and by WhatsApp, for managing consumer complaints. Taken together, these practices reflect a regulatory culture in which openness is treated as an operational commitment, not merely a formal obligation.

The PSP is operationalised annually through a *Projet Annuel de Performance (PPA)*, adopted each year by the Board of Directors, which serves as the basis for the Annual Activity Report – ARSEL's primary accountability instrument. Formal strategic reviews are planned for 2026 (intermediate) and 2028 (final). Separate annual activity reports are published regularly and available on the Agency's website going back to 2008 (<https://arsel-cm.org/rapports-annuels>).

The strategic implication is clear: formal independence—secure tenure, non-renewable mandates, dismissal protections—provides regulatory autonomy with its structural armour. But procedural openness—systematic consultation, public hearings, transparent strategic planning, rigorous accountability—provides independence with its social foundation. Together, they create what might

be termed "resilient autonomy": independence that can withstand political transitions, resist industry capture, and maintain public legitimacy over time.

For ERRA members seeking to strengthen independence, the message is dual: secure the formal institutional protections, but simultaneously invest in the practices that embed regulatory decision-making in transparent, participatory processes.

Box n.4 | **EREA: Eastern Africa's Associate Voice in the ERRA Mapping**

The Energy Regulators Association of East Africa (EREA), an associate member of ERRA, participated in this Mapping, contributing data from seven countries and ten regulatory authorities: Tanzania (EWURA, PURA and ZURA), Uganda (ERA and PAU), Kenya (EPRA), Rwanda (RURA), Burundi (AREEN), the Democratic Republic of Congo (ARE), and Somalia (NEA).

Their Gilardi Index scores range from 0.316 (Burundi) to 0.366 (Uganda), forming a compact cluster that reflects a shared regional regulatory design with limited internal variation. The only source of differentiation is the Chairperson and Board sub-index, where Uganda benefits from both a five-year mandate and a board-driven appointment mechanism, while Burundi is constrained by a sub-four-year term; across all authorities, dismissal of leadership remains possible at the appointer's discretion, suggesting meaningful room for institutional improvement on this dimension. Beyond the Gilardi framework, EREA supports a shared regional capacity-building infrastructure through the Energy Regulation Centre of Excellence (ERCE), established in 2022 and based in Arusha, Tanzania.

In the context of this Mapping exercise, EREA has reported that all seven member countries apply the full range of advanced regulatory practices surveyed alongside the Gilardi Index – including regulatory sandboxes, advisory groups open to stakeholders, regulatory impact assessment, and a publicly consulted strategic plan – a self-assessment that ERRA acknowledges with appreciation and that, if confirmed through deeper analysis, would place EREA members among the most procedurally open regulatory environments in the association's broader network

Data contributed to ERRA by EREA (Energy Regulators Association of East Africa): <https://energyregulators.org>.

Energy Regulation Centre of Excellence (ERCE): <https://erce.energyregulators.org>.

In a nutshell: independence is not merely about insulation from pressure – it is about building legitimacy through engagement.

AREA B: MULTISECTORAL JURISDICTION

THE DIVERSITY OF REGULATORY SCOPE

ERRA members have adopted strikingly different approaches to sectoral coverage, ranging from specialized energy regulators to comprehensive multi-utility authorities. The grouping system for Area B classifies members from Group 0 (single-sector jurisdiction) to Group 4 (multi-utility jurisdiction with a variety of non-energy sectors in addition to energy), capturing this institutional diversity.

The distribution reveals no dominant model. Twelve members focus exclusively on electricity and gas, or both (Groups 0 and 1), representing the traditional utility regulator archetype; half of them regulate only a single sector, either electricity or gas in isolation. Another 9 add other services that belong to the energy sector (Group 2), whilst seventeen members oversee comprehensive portfolios including different sectors further than energy: water, waste management, telecommunications, or even (in a very few cases) transport (Groups 3 and 4).

GROUP	B. Diversity of regulated sectors	N. of ERRA members	ISO country codes
0	Only one sector (only gas or only electricity)	6	BA, PK, CM, UZ, NG, EG
1	Only electricity and gas, no other sectors under regulation	6	FR, TH, AT, AL, DZ, SA
2	Different public services, all belonging to the energy sector: electricity, gas, district heating and/or liquid fuels	9	PL, CZ, TR, KG, MD, MZ, MN, XK, RO
3	Different public services belonging to two different sectors: for instance, energy and water or energy and telecom	4	GE, AE(Dubai), BG, UA
4	Different public services belonging to more than two different sectors: for instance, energy and water and waste management; or energy and telecom and water	13	GR, AZ, LT, MK, HU, AM, EE, KZ, BS, SK, OM, LV, HR
Total		38	

TABLE 3: Grouping System, distribution for Area B: multisector jurisdiction (N=38)

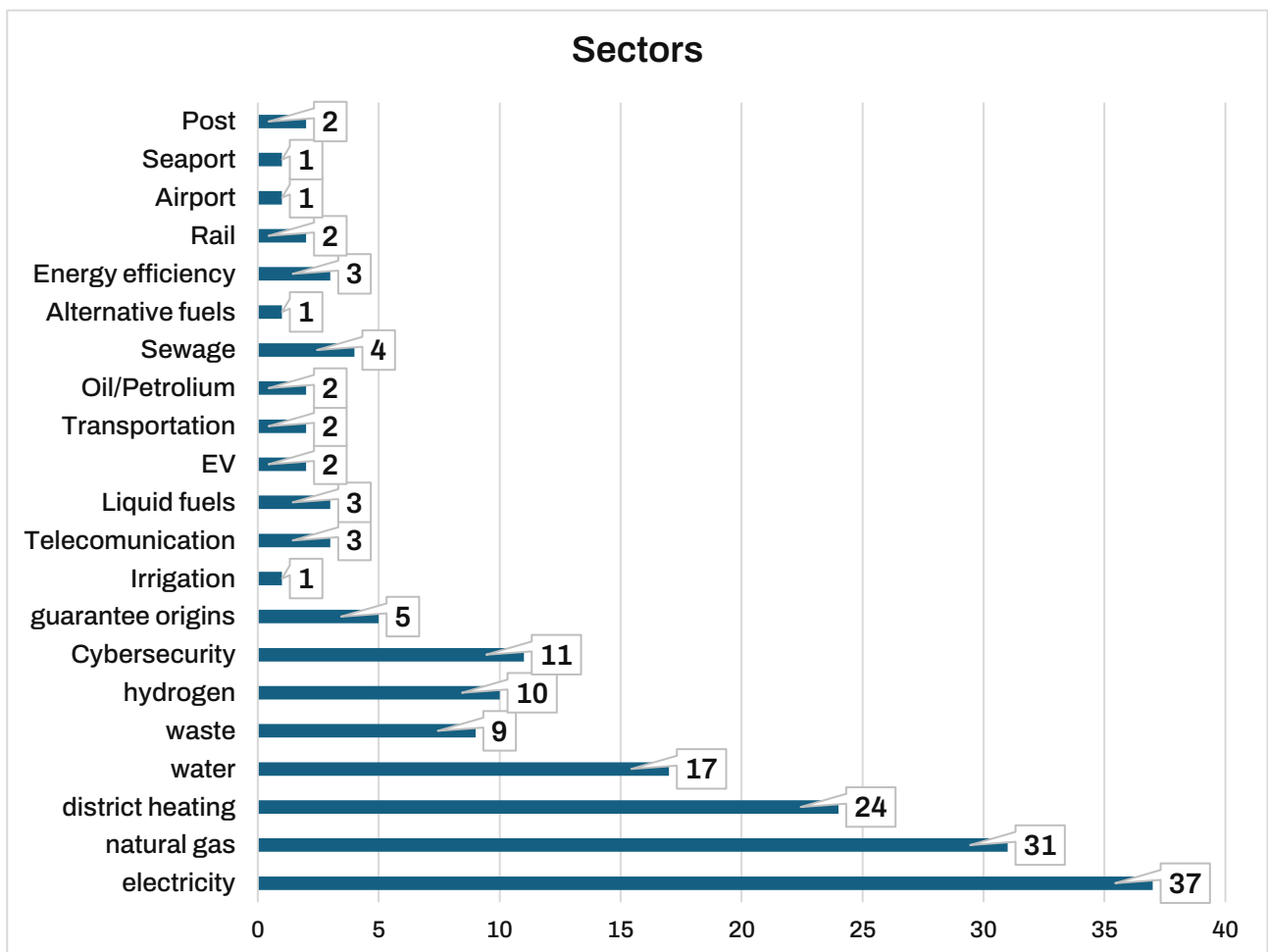
This **variation reflects fundamentally different policy choices about how to organize regulatory governance.** Some jurisdictions prefer specialized agencies with deep technical expertise in specific sectors; others favour integrated authorities that can address cross-sectoral synergies and economize on regulatory capacity. **Neither approach is inherently superior** – success depends on national context, administrative traditions, and the nature of sectoral interdependencies.

SECTORAL COVERAGE: BEYOND ELECTRICITY AND GAS

While electricity regulation is nearly universal among ERRA members, coverage of other sectors varies dramatically. Natural gas accounts for 31 members, district heating for 24, and water for 17. Emerging sectors like hydrogen (10 members), and new mandates like from cybersecurity (11) to electric vehicle infrastructure (2) are beginning to appear in regulatory portfolios as energy systems transform.

The most expansive multisector model is exemplified by the Hungarian regulator MEKH. This comprehensive scope reflects a deliberate policy choice to create a single expert body for all network industries and public services, maximizing administrative efficiency and enabling cross-sectoral policy coordination.

Lithuania’s National Energy Regulatory Council offers another variant of multisector regulation, covering energy, transportation (specifically the Klaipėda ferry), and alternative fuels. This configuration recognizes the emerging links between energy and transport decarbonization, particularly as electric mobility and alternative fuel infrastructure develop (see box n. 4).



GRAPH 8: Bar chart of sectoral coverage showing electricity, gas, district heating and water as the most typical sectors under regulatory jurisdiction

Box n.5 | **Regulatory mandates on e-mobility (SERA Saudi Arabia and EMRA Türkiye)**

The emergence of electric vehicle charging as a regulatory matter is one of the most rapidly evolving challenges facing all energy regulators, given the impact of e-mobility on grid development. Two ERRA members – Türkiye's EMRA and Saudi Arabia's SERA – offer distinct but complementary models of how regulators are adapting to this new frontier.

EMRA received an explicit regulatory mandate by the Electricity Market Law at the end of 2021, with the Charging Service Regulation entered into force in April 2022, establishing licensing procedures, rules for the operation of charging stations, and price formation principles. Under this framework, charging service prices are set freely by operators, with EMRA retaining the authority to impose price floors or caps for up to three months in case of anti-competitive behaviour. DSOs are not the direct owners or operators of public charging stations, but they play a key technical role in establishing standards and procedures for connections.

Saudi Arabia's SERA has included EV chargers in its jurisdictions and developed an EV charging framework that opens the market to any participant complying with its technical standards and DSO guidelines, without requiring DSO involvement in ownership or installation. Certified contractors carry out installation; SERA defines the regulatory framework and continues to develop it as the market evolves. Private charging installations do not require a separate meter, streamlining uptake. SERA's approach reflects a deliberate choice to create a competitive market from the outset, rather than allowing incumbent utilities to dominate the nascent infrastructure.

Together, these two cases illustrate a shared direction – maintaining competitive markets for EV charging while assigning to the regulator the role of framework-setter and market supervisor – adapted to very different starting points and market sizes.

At the other end of the spectrum, a large group of regulators maintains a narrowly defined mandate for electricity and natural gas. An interesting case could be Albania's Energy Regulatory Entity (ERE), where gas regulation is still in an early developmental stage. The Albanian approach concentrates regulatory resources on core energy sectors during market development, avoiding the capacity constraints that might arise from premature scope expansion. ERE has established the legal framework for gas market liberalization and third-party access, but the physical market infrastructure—including LNG terminals and pipeline connections—remains under construction.

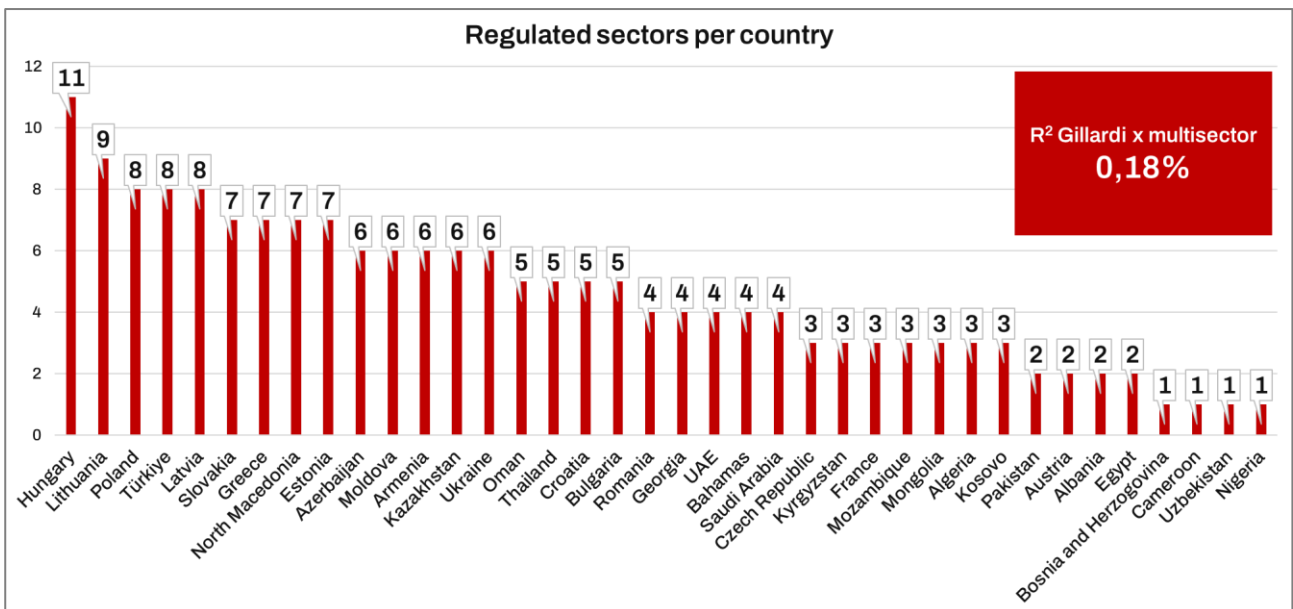
These different approaches demonstrate ERRA's institutional diversity. Multisector regulators can leverage economies of scope, apply consistent regulatory principles across sectors, and address infrastructure synergies (such as shared rights-of-way or combined heat and power). Specialized energy regulators can develop deeper technical expertise, maintain a sharper focus on sector-specific challenges like renewable integration or gas market development, and avoid dilution of scarce regulatory capacity across too many sectors. The choice depends on national priorities, administrative capacity, and sectoral maturity.

INDEPENDENCE AND SCOPE: TWO SEPARATE DIMENSIONS

The mapping exercise shows virtually no relationship between regulatory independence and sectoral scope. The correlation between Gilardi Index scores and the number of regulated sectors is essentially zero ($R^2 = 0.18\%$), indicating that regulatory independence and sectoral scope operate as separate dimensions of institutional design.

Latvian PUC, with its broad portfolio spanning eight sectors, achieves a very high Gilardi score. Others regulate three energy sub-sectors (electricity, gas, district heating) but score lower on independence due to their subordination to the Ministry of Energy and not to the number of sectors.

This independence of the two dimensions suggests they are determined by fundamentally different factors. Regulatory independence reflects governance philosophy: how a society balances expert autonomy against democratic accountability, how it protects technical decision-making from short-term political pressures, and how it institutionalizes regulatory credibility. Sectoral scope reflects administrative efficiency: whether jurisdictions prefer specialized or generalist regulators, how they allocate scarce regulatory capacity, and whether they perceive synergies across related infrastructure sectors.



GRAPH 9: Number of regulated sectors and correlation with the Independence index

The strategic implication is clear: ERRA members seeking to strengthen independence should focus on protections for leadership appointments and institutional safeguards, not on expanding or narrowing the scope. Similarly, jurisdictions considering multisector regulation—or conversely, sector-focused specialization—should make that choice based on administrative efficiency and sectoral synergies, not under the misconception that it will affect regulatory autonomy. Independence and scope are separate policy issues, each requiring distinct justification and institutional design.

CH.1 | SUMMARY OF KEY INSIGHTS

AREA A. Regulatory Independence: Maturity Through Diversity

The ERRA membership demonstrates a mature, though institutionally diverse, landscape of regulatory independence. The concentration of members in Groups 3 and 4 – 95% of the membership with high to full autonomy – challenges narratives that portray emerging markets and transition economies as uniformly weak in regulatory governance. Interestingly, Other Europe non-EU countries record a slightly higher average Gilardi index than EU countries, underlining that strong regulatory independence in the ERRA region is not confined to EU membership alone. ERRA’s strength lies precisely in this diversity: members have developed robust independence through different institutional pathways adapted to their specific political and administrative contexts.

The analysis reveals that formal independence profiles, particularly leadership appointment protections, remain the critical differentiator. The Chair & Board sub-index’s dominant correlation with overall independence provides unambiguous guidance: long fixed terms, non-renewability, dismissal only for cause, and prohibitions on holding other offices form the institutional core of regulatory autonomy. Financial and procedural independence, while valuable, play supporting rather than determining roles.

Independence is reinforced by transparency, and autonomy gains resilience through dialogue. The more robust these participatory mechanisms, the less vulnerable regulators become to both political interference and capture by powerful industry interests. When regulatory decisions emerge from transparent processes with meaningful stakeholder engagement—particularly consumer associations and civil society—arbitrary political reversals become costlier and industry dominance more difficult to sustain. Openness creates constituencies for regulatory integrity.

AREA B. Multisector Regulation: Divergent Paths to Common Goals

ERRA members have adopted fundamentally different approaches to sectoral coverage, with no single dominant model. The decision to create specialized energy regulators versus integrated multi-utility authorities reflects distinct policy priorities: technical specialization and sectoral focus versus administrative efficiency and cross-sectoral synergies. The virtual absence of correlation between independence and scope confirms these are separate institutional choices. Members can achieve high independence with narrow or broad mandates; conversely, both specialized and multisector regulators can face independence challenges if governance safeguards are weak.

CH.1 | IMPLICATIONS FOR ERRA MEMBERS

For Members Seeking to Strengthen Independence:

- **Prioritize leadership appointment protections.** Long, fixed, non-renewable terms with clear dismissal criteria provide the strongest foundation for regulatory autonomy. These mechanisms outweigh budgetary or procedural reforms in their impact on independence.
- **Advise your legislators to establish complex appointment procedures that involve multiple institutions or require supermajority approval,** increasing the political cost of appointing pliant regulators and ensuring broader consensus on leadership selection.

- **In advising your legislators, focus on dismissal protections as much as appointment mechanisms.** Clear grounds for removal—limited to legal violations, incapacity, or serious misconduct—prevent arbitrary dismissal based on regulatory decisions.
- **Adopt a transparent rule for regulatory decision-making.** Public consultation, including public hearings, and strategic plans with adequate reporting (accountability reporting on strategic achievements), reinforce formal independence in practice.

For Jurisdictions Considering Sectoral Scope:

- **Do not conflate scope decisions with independence.** Multisector and specialized regulators can both achieve high autonomy; the choice should be based on administrative efficiency, regulatory capacity, and sectoral synergies—not governance considerations.
- **Recognize that expanding scope (e.g., adding hydrogen, cybersecurity, or EV infrastructure) is increasingly common as energy systems transform.** Such expansion can leverage existing regulatory expertise but requires sufficient capacity to avoid diluting core functions.
- **Consider whether cross-sectoral synergies justify integrated regulation.** Connections between energy and water (not only for electricity generation but also for many other issues, for instance, Data centers efficiency), energy and telecommunications (for digitalization), or energy and transport (e-mobility development) may support multisector approaches in some contexts.

CHAPTER 2 | CONSUMER PROTECTION AND HOUSEHOLD REGIMES OF ELECTRICITY PRICES

AREA C: CUSTOMER PROTECTION

THE LANDSCAPE OF CONSUMER PROTECTION

The grouping system for Area C (Customer Protection) classifies members from Group 0 (no customer protection function) to Group 4 (full protection including ADR and advanced instruments). The distribution across ERRA's 38 surveyed members reveals a landscape of generally mature consumer protection, with the majority of regulators occupying the two highest categories.

GROUP	C. Customer protection	N. of ERRA members	ISO country codes
0	The Authority does not have any function of customer protection	1	AZ
1	Very limited activity of customer protection	0	–
2	Essential activity: at least setting quality standards and handling customer complaints	6	PL, AT, UZ, AE, EE, EG
3	Good activity: setting quality standards and compensation in case of breach, handling complaints and active protection for vulnerable customers	9	GE, TR, KG, HR, MD, HU, AM, MN, XK
4	Full activity, including ADR (Alternative Dispute Resolution) and other advanced instruments	22	GR, CZ, BA, PK, FR, TH, LT, AL, CM, MZ, MK, KZ, DZ, NG, BG, BS, SK, SA, LV, OM, RO, UA
Total		38	

TABLE 4: Grouping System, distribution for Area C: customer protection (N=38)

The concentration in Groups 3 and 4 – representing more than 4 out of 5 members (81,5%) – is the first notable finding. Twenty-two members have achieved the full Group 4 level: Greece, the Czech Republic, Bosnia and Herzegovina, Pakistan, France, Thailand, Lithuania, Albania, Cameroon, Mozambique, North Macedonia, Kazakhstan, Algeria, Nigeria, Bulgaria, the Bahamas, Slovakia, Saudi Arabia, Oman, Latvia, Romania and Ukraine. Nine members occupy Group 3: Georgia, Türkiye, Kyrgyzstan, Croatia, Moldova, Hungary, Armenia, Mongolia and Kosovo⁹.

Six members fall in Group 2 – Poland (which has a special acknowledgement because its regulator, URE, is deeply involved in ADR; see below for a partial advancement in respect of this Group), Austria, Uzbekistan, UAE/Dubai, Egypt (GASREG) and Estonia. In these cases, the foundational instruments

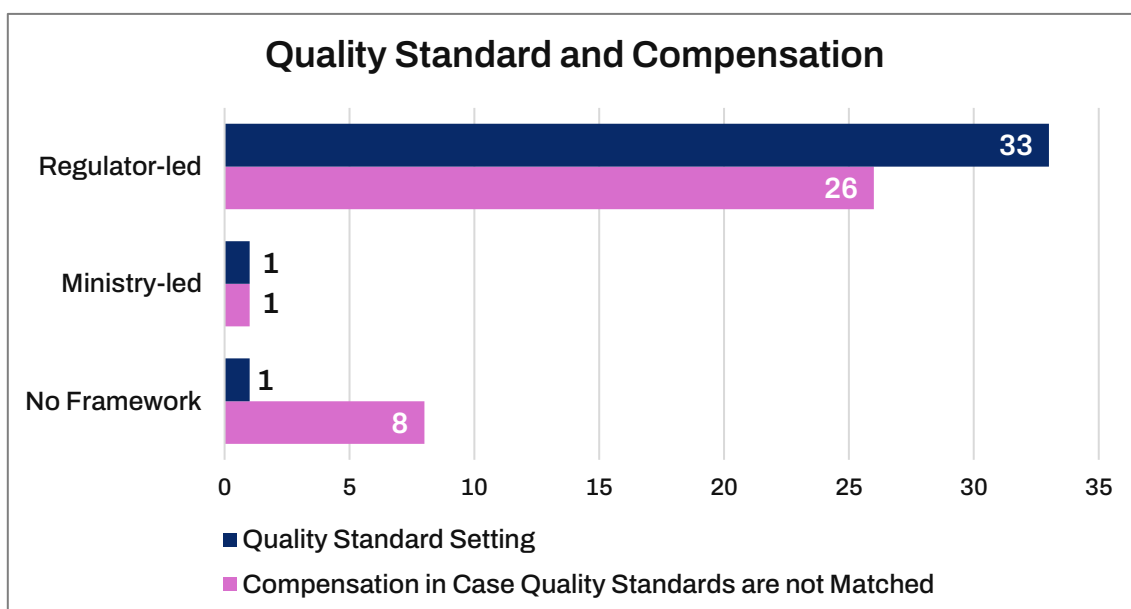
⁹ Throughout this document the symbol * refers to the following statement: This designation is without prejudice to positions on status and is in line with UNSCR 1244/1999 and the ICJ Advisory Opinion on the Kosovo Declaration of Independence.

for quality standard-setting and complaint handling are in place and operated by the regulator, but more advanced tools, such as regulator-led vulnerable customer protection or binding ADR, are less developed or absent. A single member, Azerbaijan, records Group 0, with no formal consumer protection function assigned to the regulator.

QUALITY STANDARDS AND COMPENSATIONS

Quality standard-setting is nearly universal: 33 members report that quality standards exist and are set or monitored by the regulator. In one case, standards are set by the Ministry rather than the regulator.

Consumer compensation frameworks in case of quality standard breaches are more differentiated. In most members, the regulator decides on compensation; however, several Group 3–4 members report that compensation mechanisms either do not exist (8 countries) or exist without the regulator deciding. This reveals an interesting structural gap: strong overall scores in customer protection do not necessarily imply that compensation for quality failures is fully operational or under regulator control.



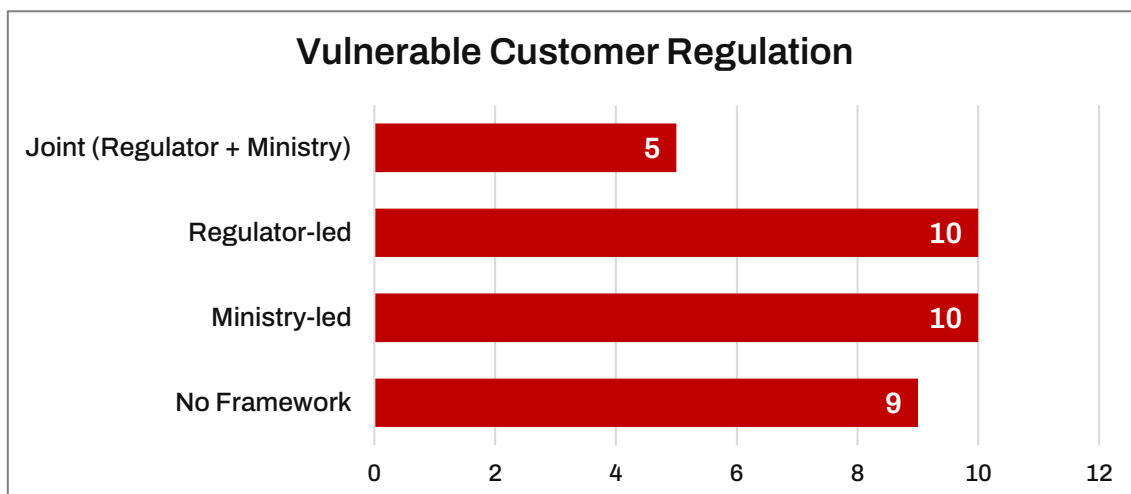
GRAPH 10: *Customer protections: settings: quality of service standards and compensations in case of standard breaching*

VULNERABLE CUSTOMERS

The treatment of vulnerable customers is among the most diverse sub-dimensions among ERRA members: three distinct institutional models emerge.

In the first model, the **regulator directly manages vulnerable customer protection**. This happens in 10 countries, where regulators define eligibility criteria for vulnerable customers, mostly based on low-income criteria, set special tariffs or bonuses, and supervise implementation. In the second model, **the Ministry or another body outside the regulator holds primary responsibility**, with 10 countries falling in this group. The regulator may play an advisory or monitoring role, but the protective regime is not its direct mandate. In the third model, **a combined approach** shares

responsibility between the regulator and the government, as in five countries, where regulation and social policy interlock.



GRAPH 11: *Customer protections: settings: vulnerable (low-income) customers discounts and other measures*

Nine members report that no vulnerable customer regulation is in place.¹⁰

Box n.6 | Algeria: A Uniform Tariff with Geographically Targeted Bill Discounts

Algeria's electricity pricing rests on a national tariff, uniform across the entire territory and established by CREG, applying to all customer types and distributed by voltage level – high voltage, medium voltage, and low voltage. Within each voltage level, several tariff options exist. For high-voltage customers (industry), two types are offered: a unique time tariff and a three-block option (peak, flat, and off-peak hours). For medium-voltage customers, four types are available: day/night, three blocks (peak, flat, off-peak), two blocks (peak/off-peak), and a unique daily tariff. For low-voltage customers, four types are offered, with some differences between residential and non-residential consumers. The tariff structure is also differentiated by time-of-use, and for low-voltage customers, a progressive tariff based on consumption volume applies in addition.

Electronic meters capable of automatically switching between time blocks are deployed to support this structure.

The uniformity of the tariff reflects a deliberate policy choice, but it coexists with a targeted social support mechanism for geographically disadvantaged consumers. For households in southern regions (including the Sahara) and high-altitude areas facing difficult climatic conditions, the State applies a discount directly on the bill rather than on the tariff itself. This discount is funded from the public service fund through the Finance Ministry. The design reflects a pragmatic regulatory choice: preserving tariff uniformity and cost-reflectiveness at the national level while addressing geographic equity through a separate, transparent subsidy channel.

¹⁰ Actually, in some countries protection of vulnerable customers is a policy whose responsibility lies with state administrations, that have historically specialized in this protection and have this expertise (this is the case of France, where protection of vulnerable customers is managed by Directorate for competition, consumers and fraud control).

ALTERNATIVE DISPUTE RESOLUTION (ADR)

ADR represents one of the most sophisticated instruments of customer protection and is a key differentiator between Groups 3 and 4 in the grouping system. In most cases, ADR exists, but the nature of the regulator's role varies significantly. To classify ADR, we considered 3 dimensions, where ADR mechanisms are reported:

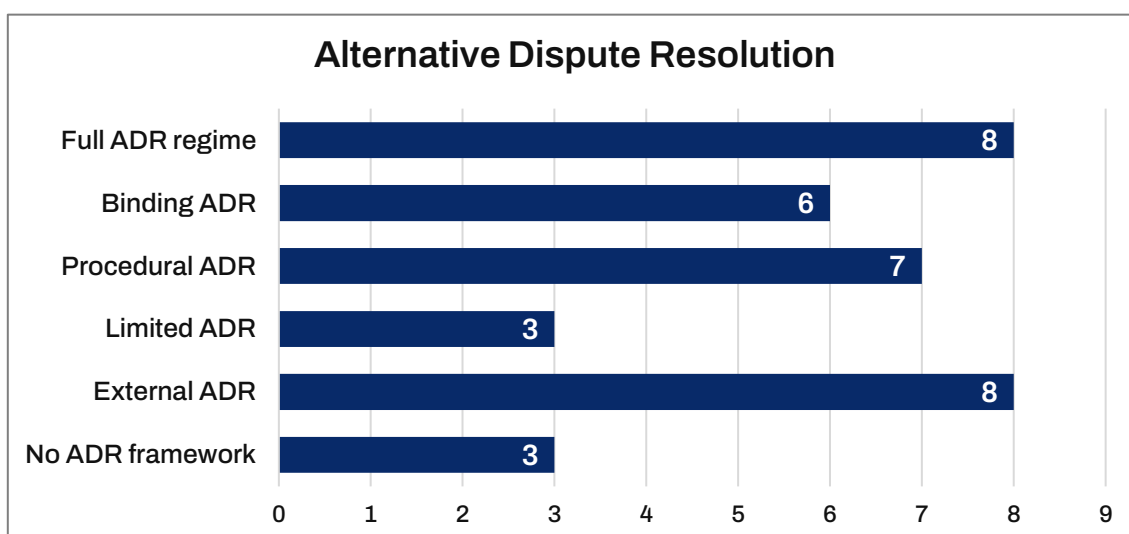
- If the regulator is involved in supervising or managing the ADR mechanism
- If the operators have the obligation to participate in the ADR procedure
- Whether the final decision of the ADR procedure is enforceable or not.

Across those three dimensions, we obtain the following typologies, as clarified in the following table.

Regulatory involvement	Mandatory operators	for	Enforceability decisions	of	ADR Typology
ADR not implemented	–	–	–	–	No ADR framework
exist, regulator not involved	Any	–	Any	–	External ADR
exist, regulator involved	Non-mandatory	–	Non-enforceable	–	Limited ADR
exist, regulator involved	Mandatory	–	Non-enforceable	–	Procedural ADR
exist, regulator involved	Non-mandatory	–	Enforceable	–	Binding ADR
exist, regulator involved	Mandatory	–	Enforceable	–	Full ADR regime

TABLE 5: *Alternative Dispute Resolution (ADR) Typologies*

Among those with ADR, the mandatory/voluntary dimension and the enforceability of outcomes matter considerably. The majority of members with regulator-involved ADR report it as mandatory for energy operators, and most also report enforceable outcomes. These distinctions help explain why the raw ADR existence score must be read alongside its institutional design.



GRAPH 12: *Customer protections: ADR (for description of typologies, see Table 5)*

Box n.7 | Albania: Regulator as Dispute Settler

Albania's ERE (Energy Regulatory Authority) performs dispute resolution as part of its regulatory mandate, acting as a formal authority for resolving disputes between licensees, market participants and customers in the electricity and natural gas sectors. Consumers may submit complaints to ERE after exhausting the supplier's or system operator's internal complaint-handling procedures. ERE Board decisions are binding and enforceable and may be appealed before the Administrative Court of First Instance of Tirana within 30 days in the electricity sector and within 45 days in the natural gas sector. This model assigns ERE an important role in resolving sectoral disputes while maintaining judicial oversight. ERE's experience with 164 electricity complaints in the most recent year illustrates the relatively limited scale of formal disputes in a market that is still transitioning towards further liberalisation.

COMPLAINT DATA: SCALE AND COVERAGE

Complaint data are available for 24 members, although comparability is limited by differences in what constitutes a "complaint to the regulator" versus complaints lodged with the operator.¹¹ The figures range from 37 electricity complaints recorded by Latvia's PUC, operating in a small, highly liberalized market, to 86,017 in Türkiye¹², which serves over 42 million household electricity customers. Between these extremes, Romania records 13,384 complaints – high relative to its market size and suggestive of unresolved quality issues – while Poland records 8,837 and Pakistan 18,188 for a much larger customer base.

Normalizing complaints by the customer base yields a different picture. Pakistan's rate of 0.52 complaints per thousand household electricity customers is essentially identical to Poland's (0.53), despite the two markets' very different maturity levels. Romania's rate of 1.52 per thousand stands out as the highest among comparable-data members, pointing to either persistent service quality issues, particularly accessible regulatory complaint channels, or both. Türkiye's headline figure of 86,017 cases translates into a rate of 2.03 per thousand electricity customers, the highest in the sample, partly due to the scale and the number of complaints related to metering and billing in a very large, recently partially liberalized market. At the other extreme, Latvia (0.04), Thailand (0.01), and Hungary (0.11) record the lowest normalized rates, but these numbers refer to complaints treated by the regulator, so they depend inversely upon the efficiency of the complaint procedures of the operators, a topic that is out of this Mapping exercise.

¹¹ Further difficulties in comparability come from sectoral issues: in 4 cases out of 24, the total number of complaints is available not separately for electricity but as a whole figure for both electricity and gas. For a more detailed analysis on procedural issues, see also ERRA, *CP COM Report on Legal Action and Processes of NRAs*, 2025, <https://erranet.org/cp-com-report-legal-actions-and-processes-of-nras/>

¹² These complaints may not be limited to billing or metering issues; they could also reflect consumer reactions to electricity price increases in recent periods.

PATTERNS AND OBSERVATIONS

Several cross-cutting patterns emerge from the analysis of Area C. The near-universal presence of quality standard-setting by the regulator shows that this foundational function has been firmly institutionalized across ERRA membership, including in relatively newer regulatory frameworks such as Mongolia and Mozambique. This represents a genuine achievement of regulatory capacity-building.

ADR, by contrast, remains more unevenly institutionalized, and its effective power depends critically on whether it is mandatory for operators and whether outcomes are legally enforceable. A regulator with nominally high overall scores that relies on non-mandatory, non-enforceable ADR occupies a structurally different position from one with binding outcomes – a distinction that the grouping level alone does not fully capture.

The institutional locus of vulnerable customer protection is a second key variable. Where the Ministry holds this function, the regulator faces inherent limitations in delivering comprehensive consumer protection – particularly during energy crises or price spikes, when vulnerable customers need rapid support. The growing trend toward combined models (regulator + government) may represent the most effective institutional design, aligning regulatory expertise with the government's fiscal and social policy capacity.

AREA D: HOUSEHOLDS' REGIMES OF END-USE ELECTRICITY PRICES

THE LANDSCAPE OF HOUSEHOLD PRICE REGIMES

Area D maps the extent to which household electricity prices are set by market competition or by regulatory intervention, and the nature and direction of any residual subsidies. The grouping system spans from Group 0 (metering gaps preventing consumption-based billing) to Group 4 (fully liberalized retail market with only Supplier of Last Resort). The distribution across 29 surveyed members reveals a wide variety of national approaches, reflecting different phases of market reform, fiscal capacity, and social policy choices.

The distribution reflects the substantial diversity of ERRA membership. **Six members have completed the transition to fully liberalized retail markets and phased out regulated prices:** Greece, the Czech Republic, Croatia, Austria, Estonia and Latvia – all EU members, for whom liberalization has been driven by the EU's internal electricity market framework. **Seven members operate in the intermediate Group 3 position:** Poland, France, Lithuania, Armenia and Romania, where a Universal Service Supplier provides regulated prices to households that do not actively choose a market supplier, with the USS price set to be cost-reflective and non-distortive.

The largest cluster – **twelve members – occupies Group 2**, maintaining regulated prices that are broadly cost-reflective but maintain cross-subsidies through block tariff structures or other mechanisms: Georgia, Azerbaijan, Bosnia and Herzegovina, Kyrgyzstan, Thailand, Moldova, Mozambique, North Macedonia, Uzbekistan, Mongolia, Kazakhstan and the Bahamas. This is the dominant model among ERRA's non-EU members, reflecting pragmatic gradualism in market reform: prices reflect costs at the aggregate level, but distributional cross-subsidies within the household segment remain in place.

Nine members of Group 1 maintain regulated household prices with explicit and substantial subsidies: Türkiye, Albania, Hungary, Algeria, Pakistan, Slovakia, Ukraine, Oman and Saudi Arabia. Nigeria (Group 0) faces a more structural challenge: metering gaps mean that significant portions of household customers cannot be billed according to consumption. Cameroon and Nigeria straddle the boundary between Groups 0 and 1, with not complete metering on one side and heavy subsidy dependence on the other side.

GROUP	D. Household electricity regimes of regulated prices	N. of ERRA members	ISO country codes
0	There are several users that cannot pay according to their consumption because of lack of metering	2	CM, NG
1	Regulated prices for households with strong subsidies to households in respect of wholesale cost-reflective price (Cameroon)	9	TR, PK, AL, HU, SK, UA, SA, DZ, OM
2	Regulated prices that are cost-reflective prices (it means: as a whole, all household customers pay the right costs), but for cross-subsidies among customer groups (for instance due to consumption blocks-based tariff	12	GE, AZ, BA, KG, TH, MD, MZ, MK, UZ, MN, KZ, BS
3	Market is liberalised but still with Universal Service Supplier for household customer that don't choose but the regulated price for this special regime for household is fully cost-reflective of the wholesale market and not distortive	7	PL, FR, LT AM, XK, BG, RO
4	Only free-market prices in fully liberalized retail market, only with Supplier of Last Resort (adjudicated via tender), no longer any USS regime a part low-income vulnerables.	6	GR, CZ, HR, AT, EE, LV
Total		36	

TABLE 6: *Grouping system, distribution for Area D: household electricity price regime (N=36; data not available for Egypt and UAE/Dubai)*

SUBSIDY REGIMES AND THEIR FINANCING

Where subsidies exist, the mapping distinguishes their scope and financing source. Among members reporting subsidy data, three broad designs emerge. **Universal household subsidies** – covering all residential customers – are in place, for instance, in Türkiye, Thailand, Albania, and Hungary. This approach, while politically convenient, creates significant fiscal exposure and tends to be regressive, as larger consumers with higher bills capture more absolute subsidy value.

Low-consumption base subsidies characterize many countries, representing a more limited model that typically concentrates support on residential customers with lower consumption through a

block-consumption tariff.¹³ Although the design alternatives are many, as a general rule, the discount for low-consumption electricity users is a burden on the shoulders of high-consumption residential users (and sometimes partly even on small business users); this is a cross-subsidy. Finally, **subsidies limited to vulnerable customers** – the most targeted approach – apply in Greece, Lithuania, and Latvia, countries that have largely completed retail liberalisation and use targeted instruments to protect those who cannot navigate market competition (see above, section on vulnerable customers).

Regarding financing of subsidies, the dominant model across all reporting members is state budget financing – reflecting that subsidies are treated as a fiscal responsibility. Pakistan is the notable exception, with mixed sources including cross-subsidies from commercial and industrial tariffs to residential consumers. This cross-subsidy approach is structurally problematic for economic efficiency, as it increases costs for productive users, and Pakistan's National Electricity Plan 2023–27 explicitly targets its progressive phase-out by FY-2026.

Box n.8 | **Pakistan: Phasing Out Cross-Subsidies**

Pakistan's electricity tariff system for residential consumers combines a detailed block structure with significant cross-subsidies from commercial and industrial customers. The regulatory framework distinguishes "protected" consumers (low-income, low-consumption households up to 100 units/month) from regular residential customers, with steeply progressive tariff blocks above this threshold. The National Electricity Plan 2023–27 sets an explicit reform trajectory: cross-subsidies to residential and agricultural consumers are to be restricted progressively to a maximum of 20% of the respective cost of service by FY-2026, with protected consumers transitioned towards direct subsidy disbursement mechanisms. NEPRA's role is one of price oversight and cross-subsidy management – the broader social policy design sits with the Ministry of Energy's Power Division. This combination of complex tariff design and a time-bound reform roadmap makes Pakistan one of the more instructive cases of managed transition from cross-subsidy dependence toward targeted, market-compatible support.

BLOCK TARIFF STRUCTURES

Block consumption tariffs are a defining feature of Group 2 regimes and are also present in several Group 1 systems. Their design – whether progressive (each block has its own price) or not (the block determines a single applicable price for all consumption) – has significant implications for efficiency and equity signals.

Armenia applies a four-block structure covering vulnerable consumers and households with consumption below 200 kWh, between 201–400 kWh, and above 401 kWh per month, each with separate day and night tariffs. The structure is non-progressive: the applicable block price applies to total consumption, not just incremental units. Albania similarly uses a two-block system (up to

¹³ For instance, in Thailand, low-consumption base subsidies were introduced in 2008 and implemented to provide under privileged households who consumes less than 50 or 90 kWh/month, (depending on energy policies in different period,) free of charge electricity.

700 kWh/month and above 700 kWh/month) applied non-progressively since April 2024, reflecting a deliberate policy to maintain simplicity while introducing some differentiation.

Mongolia introduced a three-tier progressive block tariff in 2024, explicitly designed to move from a near-flat structure towards a progressive one, while preserving a lower rate for essential consumption. The reform raised the overall average tariff from approximately 140 to 220 - 280 MNT/kWh – a significant step toward aligning electricity prices with actual supply costs, thereby reducing subsidies in a progressive way. This measure fits with the absence of liberalization in the retail market, but is less feasible with a liberalized retail market.

COST-REFLECTIVE UNIVERSAL SERVICE SUPPLIER AND FULL RETAIL LIBERALISATION

The Group 3 members – Poland, France, Lithuania, Armenia, Romania, Kosovo*, Bulgaria – share the structural feature of a Universal Service Supplier (USS) operating at regulated but cost-reflective prices. In all six cases, households that do not actively choose a market supplier remain on USS tariffs that track wholesale market costs, thereby avoiding price distortions while maintaining a safety net for passive consumers.

The five Group 4 members have completed the transition: no USS regime applies for general household customers, and regulated price intervention is limited to Supplier of Last Resort provisions adjudicated via tender. Greece provides a particularly instructive design variant: the USS tariff that remains in effect is deliberately set at 105% of the most expensive market supplier's price, creating a financial incentive for households to actively choose a competitive offer. This "incentivising USS" design represents an innovative use of residual regulatory authority to drive market engagement rather than passivity.

Box n.9 | Greece: Using the Universal Service Supplier Price as a Pro-Market Incentive

Greece's electricity retail market is liberalized, with 12 suppliers active in the household segment (8 suppliers with a market share higher than 1%). However, a residual Universal Service Supplier (USS) regime technically remains available to customers who do not make an active choice. Rather than setting the USS tariff at a competitive or cost-reflective level – which would reduce switching incentives – Greek regulator RAAEY sets the USS price at 105% of the most expensive market offer. This deliberate design makes USS the most expensive option available, creating a direct financial incentive for households to engage with market comparison tools and select a competitive supplier. RAAEY operates a dedicated online Price Comparison Tool (electricitycostcalculator.gr) to facilitate this switching.

AREA E: ELECTRICITY RETAIL MARKET

MASS MARKET LIBERALISATION

The electricity retail market liberalisation is measured through Area E. In particular, it takes into account whether the customer, and which groups of customers: only large industrial, also small business, or even households, can effectively switch supplier.

GROUP	E. Electricity retail market	N. of ERRA members	ISO country codes
0	No choice at all for final electricity customers	10	AZ, KG, PK, MZ, MN, AE, KZ, DZ, BS, SA
1	Only major industrial customers can choose their electricity supplier. No “mass free market” in the electricity sector yet	6	TH, MD, CM, UZ, NG, OM
2	Electricity switching actually possible only for non-household customers (or only above a relatively high electricity consumption threshold)	0	—
3	Electricity switching actually possible for each electricity household customer, at least on a monthly basis, and at least minimum transparency market conditions (for instance Code of Supplier Conduct, other)	9	PL, GE, TR, AL, HU, AM, XK, BG, UA
4	Switching actually possible for each electricity household customer; advanced market transparency (for instance: Price Comparison Tool independent)	12	GR, CZ, BA, FR, LT, HR, AT, MK, EE, RO, SK, LV
Total		37	

TABLE 7: *Grouping System, distribution for Area E: electricity retail liberalisation (N=37)*

GEOGRAPHICAL DISTRIBUTION

The geographical dimension of household subsidies confirms the strong regional logic of household price reform. All ERRA members in the two “no subsidy” groups (Groups 3 and 4 of Area D) belong to either EU or EU-candidate jurisdictions, or view the EU as a reference model for their energy markets. This reflects the pull of the EU internal energy market framework and the transposition of successive electricity directives as the primary driver of retail market opening.

The opposite is not entirely true, as there are countries with subsidies (Group 1 or 2 in Area D) in more or less all regions, including a few members of the EU. Caucasus, Central Asia, Southeast Asia, Africa, and the Western Balkans are jurisdictions where cost-reflective pricing may have been achieved at the aggregate level through block tariff cross-subsidies, however residual regulatory instruments persist.

RETAIL LIBERALIZATION AND SUBSIDY REGIMES: AN ASYMMETRIC RELATIONSHIP

Table 8 reveals a structural asymmetry that is analytically precise.

Region	N. of ERRA regulators	Retail market liberalisation	N. of ERRA regulators	Subsidy (groups 0-1-2)	No Subsidy (groups 3-4)	N/A
EU	13	Yes	13	2	11	-
Other Europe non-EU	7	Yes	6	5	1	-
		No	1	1	-	-
Caucasus	3	Yes	2	1	1	0
		No	1	1	-	-
Middle East and Gulf	3	No	3	2	-	1
Africa	4	No	4	4	-	-
Central Asia	4	No	4	4	-	-
Rest of the World	3	No	3	3	-	-
TOTAL	37	Yes	21	8	13	-
		No	16	15	-	1

TABLE 8: Number of regulators per region and per mass market liberalisation and subsidy in household electricity regime grouping¹⁴ (N=37, Nigeria N/A)

Among members without retail market liberalization – all jurisdictions in the Middle East and Gulf, Africa, Central Asia, and a few European states outside the European Union – subsidized household electricity prices are universal. The absence of a competitive retail market and the presence of regulated below-cost prices are structurally inseparable: without market signals to anchor pricing, cost-reflective tariffs are institutionally difficult to sustain.

The reverse, however, does not hold. Several members that have formally opened retail markets to household switching – including Türkiye, Albania, Hungary, Armenia, Kosovo*, Bulgaria, Georgia, and Ukraine – continue to operate regulated prices with significant subsidies. These are not transitional anomalies: **in most cases, subsidies are established directly by law or government decision, outside the regulator's autonomous competence.** The regulator administers the tariff framework but cannot override the political determination of prices below cost. Liberalization in these cases has opened the door to market entry and switching rights for active consumers, while the regulated

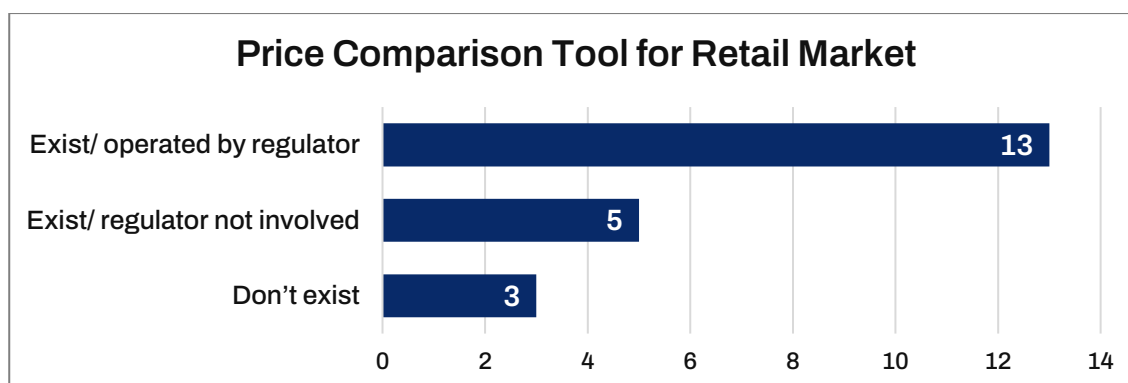
¹⁴ Regions are defined as follows: **EU (European Union)**: Austria, Bulgaria, Croatia, Czech Republic, Estonia, France, Greece, Hungary, Latvia, Lithuania, Poland, Romania, and Slovakia; **Other Europe non-EU**: Albania, Bosnia and Herzegovina, Kosovo*, Moldova, North Macedonia, Türkiye, and Ukraine; **Caucasus**: Armenia, Azerbaijan, and Georgia; **Middle East and Gulf**: Oman, Saudi Arabia, and UAE/Dubai; **Africa**: Algeria, Cameroon, Egypt, Mozambique, and Nigeria; Central Asia: Kazakhstan, Kyrgyzstan, and Uzbekistan; **Rest of the World**: Bahamas, Mongolia, Pakistan, and Thailand.

default remains politically anchored for the majority, and often so cheap that it is not rational for household consumers to go to the free market.

The implication is important for regulatory governance: **retail liberalisation and subsidy removal are two distinct policy decisions, driven by different institutional actors and timelines**. Progress on one dimension does not automatically trigger progress on the other, and ERRA members demonstrate that various combinations of the two are viable and stable configurations – each reflecting a specific balance between market development and social policy priorities, although regulators strike for cost-reflectivity, that is increasing according to Groups of Area D.

ADVANCED REGULATORY TOOLS IN COUNTRIES WITH FULL RETAIL LIBERALISATION

In fully liberalised retail markets, the regulatory function shifts from price-setting to market oversight and consumer empowerment. Price Comparison Tools (PCTs) have become a standard regulatory instrument – enabling households to compare offers, stimulate switching, and counteract information asymmetries that would otherwise favour incumbent suppliers.



GRAPH 13: Retail market liberalization: price comparison tools
(only countries with liberalised retail market are considered: see Groups 3 and 4 in Table 7)

The presence and quality of PCTs are among the markers that distinguish Group 3 from Group 4: in Group 3 markets, the USS regime itself provides a price anchor that partially reduces consumer urgency to switch, whereas in Group 4 markets, the PCT becomes the primary consumer safety net.

PCTs are a powerful tool for customers' empowerment, an evolution of consumer protection within retail market liberalization. However, further actions can be initiated by regulators in case of retail market liberalization to ensure a proper behaviour of suppliers, as described in the following box.

Box n.10 | France: CRE's principle for monitoring the coherence of supply offers and prudential regulation

The French Regulator, CRE, has defined in 2024 principles for monitoring the coherence of supply offers. The objective is to ensure that the offers made by suppliers are well correlated with the economic conditions they face. A first review is expected in the first semester of 2026. Consistency checks will initially be systematic for offers aimed at residential consumers. This will be based on the regular transmission of data by suppliers, on a monthly basis, whenever a new offer is proposed, or the prices of existing offers and current contracts are updated.

In the event of offers that are inconsistent with economic conditions, the Regulator will take corrective action, which may, depending on the circumstances, take several forms: request for correction, notification of consumers, or referral to the Competition Authority or the Directorate General for Competition Policy, Consumer Affairs and Fraud Control. In addition, to strengthen its general supervisory role, CRE has decided to broaden the scope of suppliers required to provide it on a regular basis with data about contract types subscribed by their clients, allowing for more comprehensive monitoring of the retail market and its dynamics.

Further, having observed risky behaviors among some suppliers during the price crisis period, particularly with regard to the mismatch between their downstream commitments relating to their supply offers and the upstream hedging of these offers, CRE considered that prudential regulation was necessary to regulate suppliers' hedging and risk management strategies.

CH.2 | SUMMARY OF KEY INSIGHTS

Area C: Customer Protection – Maturity with Structural Gaps

The ERRA membership demonstrates a broadly mature landscape of customer protection, with most regulators having built the core tools of quality standard-setting, complaint handling, and dispute resolution. However, structural gaps persist in specific instruments.

Quality of standard settings and compensations in case of standard breaching

The near-universal adoption of quality standards reflects genuine regulatory capacity across the membership. Yet the analysis reveals that **quality standards alone do not guarantee effective consumer protection**: compensation mechanisms for breaches, which give standards real operational weight, are absent in several members that otherwise score highly.

Alternative Dispute Resolutions

Similarly, **ADR with regulatory involvement is widespread, but its effectiveness varies substantially** depending on whether participation is mandatory for operators and whether outcomes are legally enforceable.

Vulnerable (low-income) customer regulation

The institutional locus of vulnerable customer protection remains a critical design question. Where the Ministry holds primary responsibility – as in Poland, Greece, France, and Croatia – the regulator's contribution might be limited. The trend toward combined models, where the regulator and government share responsibility with clear mandates, may represent the most effective approach for ERRA's diverse membership.

The decision on the opportunity of additional protection against price spikes has relevant policy implications, including for the State budget, and is often left to the Parliament. Furthermore, not deciding on the level of protection (intensity and access) does not mean that regulators cannot offer their expertise, helping the parliament and the administration design social support schemes.

Area D: Household Price Regimes – Divergent Paths and a Clear Direction

ERRA members span the full spectrum of household price regimes, from pre-metering conditions to fully liberalized markets. The dominant model – Group 2 (regulated, cost-reflective prices at the aggregate level but with cross-subsidies) – reflects pragmatic gradualism in reform, with regulation anchoring affordability while signalling a trajectory toward greater market exposure.

The key direction of travel is clear: movement up the grouping scale requires a combination of **metering and data infrastructure** (prerequisite for Group 1 and above), **tariff cost-reflectivity** (prerequisite for Group 2 and above), **targeted social policy mechanisms** outside regulated tariffs (prerequisite for Groups 3–4), and **market structure** – competitive entry and switching infrastructure – to sustain higher groups without consumer harm.

The experience of Group 3 (Area D) members shows that Universal Service Supplier frameworks, when properly designed with cost-reflective pricing, can serve as effective transition mechanisms – protecting passive consumers without distorting market dynamics for active ones. The Greek model of intentionally expensive USS pricing provides an innovative design that leverages regulatory authority to accelerate rather than delay market participation.

For Group 1 members (Türkiye, Albania, Hungary, Algeria), the challenge is managing the transition from broad subsidies to targeted instruments without creating affordability crises for households currently dependent on below-cost tariffs. The fiscal cost of universal subsidies – borne by state budgets in virtually all Group 1 members – is a structural pressure that argues for reform, but the social and political complexity of withdrawal requires careful sequencing and the simultaneous development of robust targeted protection mechanisms.

The Household Subsidy (Area D) vs Customer Protection Relationship (Area C)

An intuitive hypothesis – that more liberalised household price regimes (higher Area D groups) are associated with more developed customer protection frameworks (higher Area C groups) – finds partial but not universal support in the data. With a single exception, ERRA members of the higher Group in Area D all score Group 3 or 4 in Area C, consistent with the idea that competitive market environments require robust consumer protection to function fairly.

However, the correlation is not tight. Some/several members still with subsidies (Group 2 or 1 in Area D) – including, for instance, Bosnia and Herzegovina, Albania, Mozambique, North Macedonia, Kazakhstan, Bahamas and Hungary – score Group 3 or 4 in customer protection, demonstrating that strong consumer protection frameworks can be built and maintained even when prices remain regulated.

This suggests that the two dimensions reflect partially independent policy choices: consumer protection capacity reflects regulatory governance and institutional investment, while household price regimes reflect the pace and sequencing of market reform.

Retail Liberalisation (Area E) – A Neither Necessary nor Even Sufficient Condition to Eliminate Subsidies (Area D)

The analysis of retail market liberalization (Area E), read in conjunction with household price regimes (Area D), reveals a structurally asymmetric relationship. Among ERRA members, the absence of retail liberalization and the presence of subsidized prices are virtually inseparable: no ERRA member without household switching operates cost-reflective tariffs. The reverse, however, does not hold – several members that have formally opened retail markets continue to operate regulated prices with significant subsidies, established by law outside the regulator's autonomous competence.

Therefore, we cannot conclude that retail liberalization is a sufficient condition for eliminating household price distortions. But in principle we couldn't even say that it's necessary; it depends upon policy, and without constraints a good regulator could set a cost-reflective tariff in a non-liberalized tariff.

Progress on market opening does not automatically trigger subsidy removal, and the regulator's role differs fundamentally between the two: it can design and supervise switching infrastructure, but it cannot override politically-determined below-cost prices. Recognizing this distinction is essential for ERRA members navigating reform sequencing.

CH.2 | IMPLICATIONS FOR ERRA MEMBERS

For Members Seeking to Strengthen Customer Protection (Area C):

Establish binding compensation mechanisms that give operational weight to quality standards. A standard without a compensation regime is an aspiration without a consequence. Complement investment in complaint handling with enhanced consumer awareness, since complaint volumes often reflect trust in and awareness of regulatory channels as much as they reflect service quality.

Design ADR to be mandatory for energy operators and legally enforceable. Voluntary, non-binding ADR schemes provide limited consumer protection in practice and may add procedural complexity without delivering results. Where the Ministry holds primary responsibility for vulnerable customers, negotiate clear protocols for regulatory involvement in eligibility definition, monitoring, and crisis response.

For Members Managing Household Price Reform (Area D)

The sequencing of reform matters as much as the direction. Metering coverage, market structure, and targeted social protection mechanisms must be developed in parallel with tariff reform, not after it. Block tariff reforms that introduce progressive pricing signals – as Mongolia has done – represent an effective intermediate step that reduces external subsidies without reaching full market liberalisation.

Cross-subsidies from commercial and industrial customers to household consumers impose efficiency costs and undermine competitiveness. The Pakistan example of a time-bound phase-out roadmap provides a governance model worth examining: explicit targets, regulatory oversight of the trajectory, and parallel development of direct subsidy mechanisms enable reform without abrupt dislocation.

For members approaching or already in Groups 3–4, the challenge shifts from tariff design to market quality: ensuring that competitive retail markets deliver genuine benefits to consumers through transparent pricing, effective switching, and robust supplier conduct standards – all areas where the regulator's active role remains essential.

For Members Facing Retail Liberalization Challenges (Area E)

For members operating liberalized markets where subsidies persist by political determination, the regulator's strategic contribution lies upstream of the subsidy decision: investing in the “infrastructure for customer quality decision”— switching procedures, price transparency and comparison tools, supplier conduct standards, prudential guidelines for suppliers – so that when fiscal or political conditions make subsidy reduction feasible, consumers have the tools to navigate a competitive market without harm.

For members still operating regulated and subsidized regimes, the regulator's advisory role is equally consequential: steering policy choices toward less distortive subsidy designs – targeted instruments over universal ones, budget-financed transfers over cross-subsidies. Cross-subsidies between consumer groups, while sometimes useful as short-term energy efficiency signals, carry a structural risk that several liberalization experiences illustrate clearly: once embedded in the tariff architecture, they create entrenched expectations among both consumers and suppliers that make market opening extremely difficult to implement years later, requiring long and politically costly transition periods.

Cost-reflectiveness remains the “regulatory polar star”; the regulator's role is to keep the path toward it as navigable as possible – in both directions.

CHAPTER 3 | UNBUNDLING, WHOLESALE ELECTRICITY MARKETS AND REGIONAL INTEGRATION

AREA F: ELECTRICITY TSO AND DSO UNBUNDLING

THE LANDSCAPE OF UNBUNDLING

The grouping system for Area F classifies members from Group 0 (unbundling not yet relevant because the power system remains isolated or in mini-grid configuration) to Group 4 (full ownership unbundling of both the transmission and distribution operators, or equivalent ISO/ITO separation). The distribution across ERRA's 37 surveyed members – Egypt not assigned because GasReg does not have jurisdiction over the electricity sector – reveals a landscape of broadly mature transmission separation, with 30 out of 37 members (81%) occupying the two highest categories.

GROUP	F. Unbundling	N. of ERRA members	ISO country codes
0	Unbundling is not an issue because the power system is still not integrated (e.g. isolated grids or minigrids)	0	
1	Vertically integrated electricity company (generation to supply), without separation	3	AZ, MZ, AE/Dubai
2	Transmission/system operator accounting or functional separation (no ownership unbundling)	4	KG, TH, KZ, SA
3	TSO ownership unbundled or ISO/ITO model	14	PL, GR, BA, PK, FR, HR, AL, HU, AM, UZ, DZ, RO, OM, AT
4	Transmission and distribution system operators in ownership unbundling, or ISO fully separated from Transmission Operator	16	GE, CZ, TR, LT, MD, MK, MN, EE, NG, XK, BG, BS, SK, UA, LV, CM
Total		37	

TABLE 9: Grouping System, distribution for Area F: electricity TSO unbundling (N=37)

The concentration in Groups 3 and 4 is a remarkable structural finding. It reflects several overlapping dynamics: the mandatory unbundling requirements of the EU's successive electricity directives (consolidated in the Third Energy Package), the post-transition reforms of South-East European and Caucasus countries that pursued regulatory restructuring as part of EU approximation or Energy Community membership obligations, and, in some cases, structural separation driven by development bank conditionalities or national reform programmes. The result is that, across ERRA's geographically and economically diverse membership, the separation of transmission from commercial activities has become the norm rather than the exception.

The sixteen Group 4 members include not only all the EU states but also most of the Western Balkans, and, notably, several members from further afield: Georgia, Türkiye, Nigeria, Moldova, Mongolia, and Cameroon. The Turkish EMRA manages a particularly complex unbundled system,

with TEİAŞ as the state-owned but operationally independent TSO, and multiple distribution companies (DSOs) that are fully ownership-separated and, in several cases, privately owned.

The fourteen Group 3 members occupy a configuration in which the transmission operator has achieved ownership independence – or the ISO/ITO model applies – while distribution operators are separated from supply companies but not necessarily ownership-unbundled. This is effectively the minimum standard required under the EU's ITO model, and it encompasses a broadly diverse group: from France (whose TSO, RTE, operates under the ITO model and its DSO, Enedis, is an autonomous subsidiary of vertically integrated EDF group) to Pakistan and Oman (where the OETC handles transmission under an ITO-like arrangement).

At the lower end, Group 2 captures four members – Kyrgyzstan, Thailand, Kazakhstan, and Saudi Arabia – where accounting or functional separation at the transmission level has been established but falls short of either legal or ownership unbundling. Distribution remains either integrated with the supply function or separated only at an accounting level. These systems tend to have high state-ownership concentration, and the functional separation serves more as a regulatory-transparency mechanism than a structural market-access safeguard.

Three members – Azerbaijan, Mozambique, and UAE/Dubai – occupy Group 1, meaning the electricity sector remains essentially vertically integrated. For instance, Dubai's DEWA (Dubai Electricity and Water Authority) is a well-resourced, integrated utility that has deliberately maintained an integrated structure within the Emirate's specific governance context. In all these three cases, the absence of structural separation reflects deliberate policy choices – whether about maintaining state control, managing small or transitional systems, or optimising integrated infrastructure delivery – rather than mere institutional under-development.

Box n.11 | Türkiye's Three-Stage Unbundling Progressive Reform

Türkiye's electricity sector transformation offers one of the most instructive examples of sequenced unbundling outside the EU. Prior to 1993, the entire electricity system – generation, transmission and distribution – was concentrated in a single state-owned entity, TEK. A first structural break came in 1993 with the separation of TEK into TEAŞ (generation and transmission) and TEDAŞ (distribution), creating distinct institutional domains for the two network functions. The more decisive step followed the Electricity Market Law of 2001, which split TEAŞ into three separate legal entities: EÜAŞ (generation), TETAŞ (wholesale trade), and TEİAŞ (transmission and system operation). Distribution was further reorganised into 21 regional companies, whose operating rights were progressively privatised between 2009 and 2013, creating a distribution sector where private ownership is the norm rather than the exception. Today TEİAŞ operates as an independent state-owned TSO with no commercial interests in generation or supply, while the 21 DSOs are legally separated from their designated retail supply companies. The Turkish case illustrates both the potential and the complexity of multi-stage unbundling in a large, rapidly growing system: structural separation was achieved incrementally over two decades, driven by successive legislative acts rather than a single comprehensive reform.

GEOGRAPHICAL DISTRIBUTION

The geographic distribution of unbundling grouping scores reflects the institutional trajectories described above. EU members are uniformly in Groups 3 or 4, with no member below Group 3, consistent with the binding requirements of EU electricity directives. The seven Other Europe non-EU members – which include four Western Balkans countries and Ukraine, Moldova and Türkiye – are predominantly at Group 4 (five members), with Bosnia and Herzegovina and Albania at Group 3. The Western Balkans' high unbundling scores reflect Energy Community obligations, which impose EU-equivalent requirements on contracting parties.

The Caucasus displays the full range: Georgia in Group 4, Armenia in Group 3, and Azerbaijan in Group 1. Central Asia shows two members at Group 2 (Kazakhstan and Kyrgyzstan) and Uzbekistan at Group 3 – a noteworthy result, as Uzbekistan has pursued active sector reform, including the creation of the independent TSO (UzTEK) and the separation of distribution companies from the generation and supply incumbents. The Middle East and Gulf region, with three members, spans Group 1 (UAE/Dubai), Group 2 (Saudi Arabia), and Group 3 (Oman).

Region	No.	Group 1	Group 2	Group 3	Group 4
EU	13	–	–	7	6
Other Europe non-EU	7	–	–	2	5
Caucasus	3	1	–	1	1
Middle East & Gulf	3	1	1	1	–
Africa	4	1	–	1	2
Central Asia	3	–	2	1	–
Rest of World	4	–	1	1	2
TOTAL	37	3	4	14	16

TABLE 10: Number of members per region and per electricity TSO and DSO unbundling groups (N=37, Egypt N/A; definition of regions, see footnote n. 14)

Africa presents a particularly instructive spread: Nigeria and Cameroon in Group 4, Algeria in Group 3, and Mozambique in Group 1. The juxtaposition of Cameroon (Group 4) and Mozambique (Group 1) within the same region illustrates that unbundling trajectories are driven primarily by national reform programmes and international financing conditions rather than regional economic factors alone.

TSO VERSUS DSO UNBUNDLING

The mapping exercise collected sub-indicators on unbundling separately for the TSO and the DSO, revealing a significant gap between the two levels.

While the grouping exercise is based on the TSO grade of separation, the DSO picture is strikingly more varied. More than half of the respondent countries (20 out of 35) have achieved either proprietary or legal unbundling of the DSO. A limited number rely on functional separation (5 members) or accounting separation alone (only 1 member). Nine members report no DSO separation. This asymmetry reflects a structural reality well understood in European regulatory

practice: distribution unbundling requirements under the EU directives have been less stringent and less consistently enforced than TSO requirements, and for smaller systems, the business case for full ownership separation at the DSO level is weaker.

DSO SEPARATION	Number of ERRA members
No DSO separation	9
Only accounting separation	1
Functional separation (there is an independent management for DSO investment decisions)	5
Legal separation (DSO is a separated company from supply)	8
Ownership separation (DSO company's property is separated from generation and supply)	12
Total	35

TABLE 11: Electricity DSO separation (N=35; EG, UZ and AZ: N/A)

The practical consequence is that, in many countries, while the transmission network is structurally neutral, the distribution level remains an area of potential conflict of interest between network access and retail supply – particularly relevant as distributed generation and prosumer activity grow.

AREA G: WHOLESALE ELECTRICITY MARKETS

THE LANDSCAPE OF WHOLESALE ELECTRICITY PROCUREMENT

Area G maps the extent to which wholesale electricity markets – the institutional arrangements through which generators and suppliers buy and sell electricity – have been opened to competition in each member's jurisdiction. The grouping system spans from Group 0 (vertically integrated, no liberalisation) to Group 4 (fully organised national markets with day-ahead, intraday and balancing segments).

The distribution across 36 surveyed members (electricity regulators) reveals a pronounced bimodal pattern: 15 members at the frontier of full competitive markets, 10 operating in pre-competitive environments (Groups 0-1), and 11 members occupying the transitional territory between them (Groups 2-3).

GROUP	G. Electricity wholesale market development	N. of ERRA members	ISO country codes
0	Vertical bundled company, no liberalization at all	1	AZ
1	IPPs sell energy to incumbent utility under regulated price	9	KG, PK, TH, MZ, MN, AE/Dubai, DZ, BS, SA
2	Hybrid system (partly monopolistic, partly open to wholesale market)	8	GE, AM, BA, MD, CM, UZ, KZ, OM
3	National/regional wholesale market organised (at least day-ahead, possibly intraday)	3	AL, XK, MK,
4	National/regional wholesale market organised: day-ahead, intraday and balancing markets	15	PL, GR, CZ, TR, FR, LT, HR, AT, HU, EE, BG, RO, SK, UA, LV
Total		36	

**TABLE 12: Grouping System, distribution for Area #G:
Electricity wholesale market development (N=36; Egypt and Nigeria N/A)**

The 15 Group 4 members – with fully operational day-ahead, intraday, and balancing markets – essentially comprise all EU ERRA members plus Ukraine and Türkiye. Their wholesale markets differ substantially in age, liquidity, and degree of competition (EU-coupled markets are mature and liquid. The presence of Türkiye and Ukraine in this group deserves specific note: EPIAS in Türkiye manages an exceptionally active day-ahead and intraday market in one of Europe's largest power systems, while Ukraine's OREE (the Operator of the Market) has maintained organised trading – including day-ahead and intraday markets – through extraordinary wartime conditions, a remarkable institutional achievement.

At the other end of the distribution, a single member – Azerbaijan – occupies Group 0, with a vertically integrated state utility and no liberalisation at any level of the supply chain. The eight Group 1 members include structurally heterogeneous systems: the island economies of Bahamas and the still under development case of Mongolia, where system size precludes competitive wholesale trading; the Gulf states of UAE/Dubai and Saudi Arabia, where IPP frameworks have been introduced for new capacity but no organized trading takes place; and Pakistan, Thailand and Mozambique, where Independent Power Producers have been procured but remain connected to a regulated off-taker rather than to an open market. These Group 1 configurations reflect not merely institutional under-development but, in many cases, deliberate choices about how to attract investment into generation capacity within a state-dominated framework.

Algeria's borderline position reflects an active reform process. The introduction of the SKTM framework has created conditions for IPP investment and some degree of competitive procurement, while a fully organized exchange-based market does not yet exist. Algeria is perhaps the clearest example within the ERRA membership of a jurisdiction in transition from the IPP model to a hybrid competitive market. Another interesting case is Kazakhstan.

Box n.12 | **Peer-to-Peer Trading (ERC Thailand)**

Thailand's Energy Regulatory Commission (ERC) has taken meaningful steps to enable peer-to-peer (P2P) electricity trading, despite the persistence of the Enhanced Single Buyer model as the dominant market structure. Since 2019, the ERC has operated a dedicated regulatory sandbox programme, hosting at least eight pilot projects involving a diverse range of actors – real estate developers, electric utilities, universities, chemical manufacturers, and EPC contractors – testing direct P2P trading models on blockchain-based platforms across community, university campus, microgrids and industrial settings. Notable pilots include the WHAUP's industrial estate platform in Rayong, aimed at generating the operational and regulatory evidence needed to underpin a future permanent framework.

In parallel, the broader market liberalisation agenda advanced significantly in 2024/25, when the National Energy Policy Council approved a Direct PPA pilot programme (capped at 2 GW) allowing renewable generators to contract directly with large corporate offtakers – particularly data centres – via a forthcoming Third-Party Access (TPA) Code currently being finalised by the ERC. The new program, overseen by the Energy Regulatory Commission (ERC), will allow renewable power producers to sell electricity directly to large corporate consumers—particularly data centre operators—under a regulated structure designed to expand access to green energy and attract high-value foreign investment. Unlike the traditional “single buyer” model, in which the state utility acts as the exclusive intermediary, the new regime will enable private contracting between generators and corporate offtakers to use the national transmission grid under Thailand's forthcoming Third-Party Access (TPA) Code. Renewable energy resources includes, for example, solar, wind, etc. possibly with BESS, with a second phase anticipated once regulatory and operational mechanisms are proven.

Box n.13 | **Kazakhstan: A Hybrid Market in Active Transition**

Kazakhstan's KOREM (Kazakhstan Electricity and Power Market Operator) has been developing an electricity market since the early 2000s, but the market remains predominantly bilateral, with a day-ahead exchange operating at limited scale. The regulator AREK operates within a framework where large industrial consumers can access the free market while residential and small commercial consumers remain under regulated tariffs. The Energy Minister's strategic programme for 2030 envisages a deeper market transition, including the introduction of a balancing mechanism and expansion of exchange trading.

What makes Kazakhstan analytically notable for the ERRRA mapping is the explicit coexistence of competitive elements (free market for industrial consumers) and regulated elements (population tariffs, cost-based network pricing) within a single market design. This hybrid model reflects a calibrated political economy choice: market signals for large actors, social protection for households, all within a system undergoing a managed transition toward greater competitive depth.

THE CORRELATION WITH UNBUNDLING

The relationship between Area F (unbundling) and Area G (wholesale markets) is not merely logical but is clearly visible in the data. Every Group 4 member on the wholesale market side (Area G) has at least one Group 3 member on unbundling (Area F). The converse, however, does not hold: several members of Groups 3 and 4, as for unbundling (Area F), have not progressed to competitive wholesale markets. (Area G).

This asymmetry confirms the classic insight in regulatory sequencing: structural separation is necessary but not sufficient for market development. The institutional separation of networks from commercial activities creates the conditions for access neutrality; translating those conditions into actual competition requires additional market design, regulatory capacity, and – critically – political commitment to managing the distributional consequences of liberalisation.

The outlier case of Cameroon (Group 4 unbundling, Group 2 wholesale market) makes this point vividly. ARSEL in Cameroon oversees a system with full ownership separation of the transmission and distribution operators – an institutional achievement that outstrips many wealthier ERRA members – but where the wholesale market remains a hybrid arrangement. The structural form has been built; the competitive substance has not yet followed.

GEOGRAPHIC DISTRIBUTION

The geographic concentration of Group 4 wholesale market members in Europe – EU and Other Europe non-EU – is the dominant feature of the distribution. All thirteen EU members and three of the seven Other Europe non-EU members have fully organised markets; the remaining four other Europe non-EU members cover the range from hybrid (for instance: Bosnia and Herzegovina, Moldova, North Macedonia) to organised day-ahead (Ukraine and Türkiye).

The Rest of World cluster – Pakistan, Thailand, Mongolia, and the Bahamas – forms a uniform Group 1 block, but for entirely different structural reasons: Thailand's PTT-dominated system with a small competitive segment differs fundamentally from Pakistan's NTDC/CPA-based bilateral market, which in turn differs from the Bahamas' isolated island utility. The uniformity of the group score masks the diversity of the underlying configurations.

Region	No.	Group 0	Group 1	Group 2	Group 3	Group 4
EU	13	–	–	–	–	13
Other Europe non-EU	7	–	–	2	3	2
Caucasus	3	1	–	2	–	–
Middle East & Gulf	3	–	2	–	1	–
Africa	3	–	2	1	–	–
Central Asia	3	–	1	2	–	–
Rest of World	4	–	4	–	–	–
TOTAL	36	1	9	7	4	15

TABLE 13: Number of members per region and per wholesale markets group (N=36, Egypt and Nigeria N/A; for definition of regions, see footnote n.14)

AREA H: REGIONAL ELECTRICITY MARKETS

THE LANDSCAPE OF REGIONAL ELECTRICITY MARKETS

Area H maps the degree to which national electricity wholesale markets have been integrated into broader regional systems, with a market-coupling algorithm to have common prices, allocate cross-border capacity, and harmonise market rules across borders.

The grouping system spans from Group 0 (no regional integration, national system in isolation) to Group 4 (full integration: a unified regional market with harmonised grid codes, as in the EU's Internal Electricity Market). The analysis covers 37 of the 38 surveyed members, with Egypt classified as not assigned due to either the absence of an answer or an ERRA-member regulator without jurisdiction on electricity.

GROUP	H. Regional coordination of electricity wholesale market	N. of ERRA members	ISO country codes
0	No electricity market integration at regional level	5	AZ, CM, MN, BS, PK
1	Early stage of regional market integration: bilateral contracts only	16	BA, GE, KG, TH, MD, MZ, MK, AM, UZ, AE/Dubai, KZ, DZ, UA, SA, OM, TR,
2	Shallow market integration: wholesale market at regional level (day-ahead market coupling)	2	AL, XK
3	Deep market integration: wholesale market at regional level	2	NG, BG
4	Full market integration: as level 3 + regional unified grid codes (like IEM in EU)	12	PL, GR, CZ, FR, LT, HR, AT, HU, EE, RO, SK, LV
Total		37	

TABLE 14: *Grouping System, distribution for Area H: regional electricity markets (N=37)*

The distribution is heavily shaped by the EU bloc: the twelve EU members in Group 4 – all EU member states in the ERRA membership except Bulgaria – are fully integrated into the Single Day-Ahead Coupling (SDAC) and Single Intraday Coupling (SIDC) that form the operational core of the Internal Electricity Market. Their regional integration is not merely bilateral but multilateral, governed by harmonised network codes (Connection Codes, Operational Codes, Market Codes) developed under ENTSO-E under the supervision of ACER.

This represents the most advanced electricity market integration anywhere in the world and provides a structural benchmark that no other ERRA regional configuration currently matches.

Bulgaria's Group 3 classification – as the only EU member not at Group 4 – reflects a specific technical situation. While Bulgaria participates in certain regional market arrangements and its TSO ESO is a full ENTSO-E member, the full SDAC day-ahead coupling for the Bulgarian market had not been completed during the survey period. This is a transitional status rather than a structural divergence, and Bulgaria's trajectory toward Group 4 can be expected to continue as the SEE coupling process advances. The pairing of Bulgaria and Nigeria at Group 3 is analytically

coincidental – their Group 3 statuses arise from entirely different structural contexts – but it illustrates how summary scores can group heterogeneous situations.

Box n.14 | **Nigeria: the anchor of the West Africa Power Pool (WAPP)**

Nigeria's Group 3 regional classification reflects its central role in the West Africa Power Pool (WAPP), the ECOWAS initiative launched formally in 2006 to develop a regional electricity market across sixteen West African countries.

Nigeria, as the largest electricity producer in the region, is the anchor member of WAPP's interconnection programme, with existing transmission links to Benin/Togo (330 kV line) and ongoing development of additional cross-border transmission capacity.

The Nigerian regulator NERC participates in regional regulatory coordination through ERERA (ECOWAS Regional Electricity Regulatory Authority), which provides the governance framework for WAPP market development. While WAPP has not yet achieved the organised day-ahead coupling that would warrant a Group 4 classification, the depth of market integration – including regional energy trading, coordinated dispatch and regulatory cooperation – is sufficiently advanced to distinguish Nigeria from the Group 1 bilateral-contracts-only position.

WAPP represents one of the most ambitious regional electricity market integration initiatives in the developing world, and Nigeria's regulatory engagement with it provides a model that may be of interest to other African ERRA members.

Box n.15 | **Integration of Baltic Electricity Market (Lithuania, Latvia, Estonia)**

For decades, the Baltic electricity systems operated in isolation from Western Europe, synchronized with the Russian grid and dependent on it for frequency regulation. This changed in early 2025, when Estonia, Latvia and Lithuania successfully completed the switch to synchronous operation with Continental Europe – a landmark both technically and geopolitically. The transition was accompanied by equally significant steps on the market side. The three Baltic TSOs jointly joined the pan-European balancing platforms MARI and PICASSO, which allow system operators across Europe to procure the reserves needed to keep the grid stable – such as fast-acting automatic responses and manually activated reserves – from the cheapest available sources across borders, rather than relying solely on domestic providers.

A dedicated Baltic Balancing Capacity Market was also launched, enabling the three countries to share and exchange reserves among themselves under harmonised rules. Together, these developments mark the completion of a long integration journey: the Baltic wholesale market, already coupled with Nord Pool for day-ahead and intraday trading since the early 2010s, is now fully embedded in the European electricity system at every time horizon, from forward trading down to real-time balancing.

GEOGRAPHICAL DISTRIBUTION

The geographic distribution of regional market integration makes the EU-versus-rest-of-world divide starker than in Areas F or G. Outside the EU, no member achieves Group 4, and only four (Bulgaria, Nigeria, Albania, Kosovo*) reach Groups 2 or 3. The implications are significant: while unbundling norms have diffused broadly across ERRA's membership through various institutional channels, and while wholesale market development has progressed in a sizeable minority, regional electricity market integration remains almost exclusively a European phenomenon within the ERRA context.

This is in part a function of geography and grid topology (the EU Internal Electricity Market is enabled by a densely meshed synchronous continental grid for which no equivalent exists elsewhere), but also a function of the specific institutional architecture that Europe has built around ENTSO-E, ACER, and the network codes – architecture that other regions are only beginning to consider, as WAPP in West Africa illustrates.

Region	No.	Group 0	Group 1	Group 2	Group 3	Group 4
EU	13	–	–	–	1	12
Other Europe non-EU	7	–	5	2	–	–
Caucasus	3	1	2	–	–	–
Middle East & Gulf	3	–	3	–	–	–
Africa	4	1	2	–	1	–
Central Asia	3	–	3	–	–	–
Rest of World	4	3	1	–	–	–
TOTAL	37	5	16	2	2	12

TABLE 15: *Number of members per region and per regional market integration groups (N=37, Egypt N/A; for definition of regions, see footnote n.14)*

CH.3 | SUMMARY OF KEY INSIGHTS

Area F: Unbundling — Mature but Asymmetric

The overwhelming concentration of ERRA members at Groups 3 and 4 confirms that structural separation of transmission from commercial activities has become a near-universal regulatory norm within the association – even among members operating outside the EU regulatory perimeter.

Certain foundational regulatory standards have diffused broadly across ERRA's membership through multiple institutional channels: EU requirements, Energy Community obligations, World Bank and development finance conditions, and peer learning within ERRA itself. This is suggested by the alignment of over 81% of the concentration in Groups 3 and 4 (30 of 37 members) for Unbundling (Area F), broadly comparable to the 95% and 81.5% concentrations seen in Areas A (regulatory independence) and C (customer protection).

The key remaining differentiation lies at the DSO level, where advanced separation levels are achieved by only about one-third of members. As distributed energy resources – prosumers, batteries, demand response, electric vehicles – grow in relevance, this DSO gap becomes

increasingly consequential: a DSO that is functionally but not ownership-separated from a retail supplier has structural incentives to manage its network in ways that favour the affiliated supplier's customers. Strengthening DSO independence – whether through ownership separation or through robust functional separation enforced by independent regulators – could therefore become one of the more consequential unbundling challenges for ERRA members in the coming decade.

Areas G and H: Markets and Integration — Deep Divergence, Distinct Logics

The wholesale market (Area G) and regional integration (Area H) data tell a more differentiated story than the unbundling approach. The bifurcation between a competitive bloc (EU, Other Europe, Türkiye, Nigeria at the frontier) and a pre-competitive bloc (Rest of World, most of the Middle East and Gulf, parts of Africa and Central Asia at the other end) is both more pronounced and more structurally entrenched than in Area F. The middle tier of hybrid-market members is analytically the most important segment for ERRA's work: these are members whose regulatory choices today will determine whether the transition to competitive markets proceeds or stalls.

Advanced regional integration (Area H, Group 4) remains essentially a European phenomenon within the ERRA context, with the twelve full IEM members at Group 4, and only Bulgaria (Group 3), Nigeria (Group 3), Albania and Kosovo* (Group 2) achieving meaningful regional market depth outside the fully integrated EU cluster. Each of these is a different story to tell (see dedicated boxes). The implication is not that non-European ERRA members are failing at regional integration, but that the specific institutional conditions that enabled EU-level market coupling – a synchronized continental grid, supranational regulatory authority, mandatory network codes, and decades of incremental harmonization – do not currently exist in other ERRA regions. What exists, particularly in West Africa (WAPP) and the Gulf (GCCIA), are precursors of regional integration that deserve recognition and support.

CH.3 | IMPLICATIONS FOR ERRA MEMBERS

For Members Seeking to Strengthen TSO unbundling (Area F)

Members operating in Group 1 or 2 who are beginning structural separation processes should first focus on TSO ownership unbundling, which provides the strongest signal of network neutrality for generators and suppliers. The data show that this step – once taken – is rarely reversed, and it creates the institutional foundation for subsequent market development. For members already in Group 3 or 4 on TSO unbundling, the priority should shift to DSO functional and ownership separation, as this level of the network becomes increasingly important for managing distributed resources, smart metering, and prosumer activity.

For Members Introducing or Reinforcing Wholesale Market Reform (Area G):

Members in the hybrid Group 2 position face the classic challenge of transitional wholesale market design: how to expand competitive procurement while managing the distributional consequences for consumers and the political economy of incumbent utilities. The evidence from more advanced ERRA members suggests that clear sequencing matters: establishing a day-ahead exchange with transparent price formation (Group 3) before attempting full market liberalization (Group 4) allows regulators and market participants to build capacity, identify market design failures, and manage the

transition of regulated tariff customers. The Group 3 members provide directly relevant peer learning for Group 2 members, considering this next step.

For Group 1 members operating IPP frameworks without organized trading, the regulatory challenge is different: it involves designing procurement mechanisms (competitive tenders, capacity auctions, power purchase agreement structures) that maximize the efficiency of generation investment under state-dominated market conditions. Several ERRA members – including Saudi Arabia's SERA with its renewable energy programme, Pakistan's NEPRA with its competitive generation licensing, and Thailand's ERC with its hybrid regulated-competitive structure – have developed sophisticated procurement frameworks that others in this group may find instructive.

For Members Integrating on a Regional Basis Wholesale Markets (Area H):

For EU and Other Europe non-EU members at Group 4 or approaching it, the priority is completing the remaining steps in the EU Internal Electricity Market – including cross-zonal capacity allocation optimisation, full intraday coupling, and implementation of the network codes. For Western Balkans members in Groups 1 and 2, the Energy Community roadmap provides the institutional scaffolding; the challenge is to accelerate the operational and regulatory reforms needed to participate in the SDAC and SIDC.

For non-European ERRA members, the message from the data is more structural: regional electricity market integration of the EU type is not a near-term prospect in most cases, but the preconditions can be put in place. These preconditions include cross-border transmission investment, bilateral synchronisation or HVDC interconnection, operational coordination between TSOs, and – crucially – the development of regional regulatory frameworks (such as the ERERA/WAPP model in West Africa or a strengthened GCC regulatory dimension in the Gulf) that can provide the legal and governance infrastructure for organised regional trading. ERRA's associative value – its role as a platform for peer learning and shared methodology across diverse regulatory systems – is perhaps nowhere more evident than in this space, where members at vastly different stages of market development can draw on each other's institutional experience.

CHAPTER 4 | ELECTRICITY NETWORKS: INCENTIVE REGULATION AND TARIFF STRUCTURE

AREA I: REGULATORY INCENTIVES TO GRID OPERATORS

THE LANDSCAPE OF NETWORKS

Before entering the grouping system for regulatory incentives to grid operators, it's useful to provide some aggregated data on transmission and distribution networks and the number and size of DSOs.

ERRA members aggregated by Region [n.].		Transmiss. Network length [000 km]	Distribut.í Network length [000 km]	Total number of DSOs [n.]	Number of DSO > 1M customers [n.]	Number of Total Customers [million]
EU	13	210.0	4088.1	1000	23	100.5
Other Europe non-EU	7	117.8	2692.0	63	25	73.7
Caucasus	3	9.7	131.6	3	0	2.7
Middle East & Gulf	3	114.6	946.1	4	n/a	13.7
Africa	5	110.0	1056.2	3	3	68.2
Central Asia	3	45.0	356.1	13	1	8.5
Rest of World	4	69.2	1549.4	37	10	66.8
TOTAL	38	676.3	10819.5	1123	62	334.2

TABLE 16: Lengths of transmission and distribution network and number of DSO (both total and larger size DSO only), per region (ERRA Members included: N=38); for definition of regions, see footnote n.14

The grouping system for Area I measures the sophistication of incentive regulation applied to electricity network operators – in practice predominantly to distribution system operators (DSOs), though several regulators also apply incentive frameworks to transmission system operators (TSOs). The five levels capture a progressive ladder from the complete absence of incentive regulation (Group 0) to the most advanced incentive regulation (Totex + output-based frameworks, Group 4).

GROUP	I. Regulatory incentives to grid operators	N. of ERRA members	ISO country codes
0	No incentive regulation	5	AZ, BA, MN, AE, BS
1	Only price-cap or similar (on Opex only)	3	KG, EE, UA
2	Price-cap or similar on opex and incentives (reward and penalty) on quality of supply (and possibly for losses)	17	GR, GE, PK, TH, LT, HR, AL, CM, MZ, MK, HU, UZ, KZ, BG, SA, OM, AM
3	Price-cap or similar on both opex and capex and/or incentives (reward and penalty) not only on quality of supply and losses, but also on other kind of output of grids (innovation, resilience, energy efficiency, etc.)	8	PL, CZ, TR, MD, DZ, XK, RO, SK
4	Totex incentives related to business plan, Capex sharing and other advanced output-based incentives	3	FR, AT, LV
Total		36	

TABLE 17: *Grouping System, distribution for Area I: incentive regulation for grid operators (N=36)*

The dominance of Group 2 (17 members, 47%) reflects the degree to which SAIDI and SAIFI – the two standard international indicators of service continuity – have become the reference frame for electricity distribution incentive regulation across ERRA's membership. The structural logic is compelling: both indicators are computable from quality data most regulators already collect, they are directly interpretable by consumers and policymakers, and they can be combined with either reward/penalty or asymmetric penalty mechanisms (the latter being more common in members with less developed regulatory capacity).

Ukraine (NEURC, Group 1) presents an instructive special case: a well-developed price-cap methodology exists for DSOs, but the wartime adaptation of 2023–2025 has suspended quality adjustment mechanisms, temporarily frozen efficiency targets, and extended convergence periods – a deliberate regulatory response to the impossibility of penalizing operators for outages attributable to military hostilities. This does not reflect a structural weakness in the framework but a pragmatic adaptation to extraordinary circumstances.

THE OPEX–CAPEX BOUNDARY AS THE CURRENT REFORM FRONTIER

The transition from Group 2 to Group 3 marks the most important qualitative boundary in this area: the incorporation of capital expenditure within the incentive framework and the expansion of regulated outputs beyond service continuity. This is where the bulk of regulatory reform activity is currently concentrated across the ERRA membership.

Czech Republic (ERU) is a detailed example: the regulatory framework for the 2026–2030 period explicitly incentivises investment in system robustness (capitalised investments relative to depreciation), ICT and digitalisation, loss reduction (minimum lengths of new cable and transformer upgrades), and metering coverage – across both TSO and DSOs. Slovakia presents a comparable architecture. These frameworks represent a sophisticated attempt to align capex with verifiable output outcomes rather than treating investment as an input to be approved.

Türkiye (EMRA), combines Opex efficiency benchmarking via Data Envelopment Analysis – using network length, consumer numbers, substation count, and district count as outputs – with capex benchmarking across companies, allowing rewards and penalties on capital efficiency. This Opex + Capex combined approach, while stopping short of a full Totex framework, captures the essential logic of Group 3.

Box n.16 | **Moldova (ANRE) – a rigorous penalty-only framework**

Moldova's National Regulatory Authority in the Energy sector (ANRE) operates an incentive framework for electricity distribution based on a multi-indicator quality approach.

Quality indicators regulated: AIT (Average Interruption Time), ENS (Energy Not Supplied), SAIDI, SAIFI, CAIDI. Force-majeure events are excluded from the incentive calculation using a statistical 2.5-sigma filtering methodology – a technically rigorous approach that reduces the risk of penalising operators for events outside their control.

The framework applies penalties only (no symmetric reward), with the regulator noting that no penalties were applied in the current period – a result that may reflect both operator compliance and the framework's transition phase.

Moldova's distribution network covers 57,016 km and its transmission network 4,725 km. The incentive regulation applies to the DSO. The TSO (Moldelectrica) is regulated under a separate framework.

Detailed performance data are available in ANRE's Annual Activity Report 2024.

THE TOTEX AS THE NEW REGULATORY FRONTIER

Only three members have reached Group 4, and they share a common thread: integrating operating and capital expenditures into a unified business-plan framework, with regulatory review against a negotiated or benchmarked plan rather than annual cost approval. France (CRE/TURPE 7) is the most detailed case in the membership, combining multi-year business-plan regulation with an innovative incentive for TSO and DSO to contractualise demand-side flexibilities as alternatives to network investment – effectively creating a market signal for non-wire alternatives. Austria (E-Control) operates a Totex framework with business-plan regulation for both gas and electricity DSOs, consistently achieving among the lowest SAIDI figures in the ERRA membership (49.7 minutes in 2023, net of exceptional events). Latvia (PUC) is undergoing a methodology revision that may consolidate or refine its current framework.

Box n.17 | France's integrated incentive framework for grid regulation

France's *Commission de Régulation de l'Énergie* (CRE) operates a unified tariff framework – TURPE (*Tarif d'Utilisation des Réseaux Publics d'Électricité*) – covering both the TSO (RTE, 100,000 km of transmission cables) and the dominant DSO (Enedis, 1.3 million km of distribution cables, covering 95% of mainland France). The 2025–2028 edition (TURPE 7) reflects the most recent reset.

On service quality, the DSO framework incentivizes five continuity indicators: average duration of outages (LV and MV), average frequency of outages (LV and MV), and a specific compensation mechanism for outages exceeding five hours. The TSO is incentivised on duration, frequency, and compensation for outages exceeding three minutes at high voltage. In both cases, exceptional events (natural disasters, third-party accidents) are formally excluded from the incentive calculation.

The most notable innovation in TURPE 7 is the explicit incentive for Enedis and RTE to contractualise demand-side flexibilities – from aggregators, prosumers, or storage operators – as alternatives to capital investment ('non-wire alternatives'). This introduces a degree of Opex–Capex neutrality that few regulatory frameworks in the ERRA membership have formalised.

Reported 2024 figures for Enedis: SAIDI LV 71.6 min/year (net); SAIDI MV 48.1 min/year (net). For RTE: SAIDI 2.5 min/year (net). Penalties applied to Enedis in 2024 amounted to 0.008% of allowed revenues – reflecting a network operating very close to its target band.

Capex incentive regulation for RTE is described in the ERRA report on Grid investments (2025).

Box n.18 | Austria: TOTEX incentive regulation and quality of service standards

Austria's energy regulator E-Control is one of the few ERRA regulators applying TOTEX-based efficiency benchmarking, applied to both electricity and gas distribution system operators. The regulatory rationale, set out explicitly in E-Control's benchmarking methodology, is that limiting efficiency analysis to operating expenditure alone would create perverse incentives – operators could reclassify costs between opex and capex categories, or prefer capital-intensive solutions solely to improve their benchmarking score. By using total expenditure (OPEX + CAPEX) as the single input variable, E-Control ensures that efficiency assessment is neutral to the operator's choice between operational and capital solutions. The efficiency score derived from the TOTEX benchmarking is also used to determine the efficiency-dependent weighted average cost of capital (WACC_{eff}), thereby directly extending the incentive for efficient behaviour into the remuneration of invested capital.

The 5th regulatory period for electricity DSOs (2024–2028) was shaped by a concrete operational challenge: the surge in renewable energy connections. Grid access applications quadrupled from 53,926 in 2021 to 199,861 in 2022, pushing many distribution system operators to their operational limits and reducing the compliance rate with the quality standard for grid access processing from 98% to 89%. The expected expansion is around

100,000 additional PV metering points per year through 2030 to meet the target of 11 TWh of additional PV generation, indicating the pressure on DSOs is structural, not temporary.

E-Control's response combined incentive regulation innovations with quality-of-service standards. On the incentive side, the 5th regulatory period introduced a separate WACC for new investments, reflecting both the need to finance energy transition infrastructure and changed interest rate environment. A lower rate applies to the existing regulatory asset base up to 2023. Other measures were adopted to prevent cost shortfalls that could have undermined DSO investment capacity, including an operating-cost factor for the connection of new generation metering points. Broad consensus has been recorded among grid operators regarding the current regulatory model for the 5th regulatory period: only one DSO appealed against.

On the quality-of-service side, E-Control developed a Grid Connection Action Plan with 14 concrete measures – including process standardisation for connection assessments, online application portals, simplified compliance procedures, and transparency on available grid capacities – and amended the Ordinance on Electricity System Service Quality to introduce additional quality standards and deadlines aligned with the Action Plan. This dual approach – financial incentives to enable investment alongside operational quality standards to accelerate connection processes – reflects a regulatory framework in which incentive regulation and quality requirements are designed as complementary instruments addressing the same structural challenge.

The Austrian supply reliability is very good: the 2022 SAIDI (excluding regional exceptional events) reached 37.7 minutes/customer per year – the second-lowest value since records began.

AREA J: ELECTRICITY NETWORK TARIFF STRUCTURE

THE LANDSCAPE OF NETWORKS TARIFFS

The grouping system for Area J focuses on the tariff structure for low-voltage electricity network access for household customers – the politically most visible tier of customer groups.

The five levels capture the share of network costs recovered through a fixed or capacity-based charge (as opposed to volumetric energy consumption) at the national average household consumption level.

GROUP	J. Electricity network tariff structure	N. of ERRA members	ISO country codes
0	Not yet separated tariff for network component	3	MZ, MN, BS
1	100% volumetric network tariff	16	GE, AZ, TR, PK ¹⁵ , AL, MD, CM, AM, AE, EE, KZ, DZ, NG, RO, UA, OM
2	Mixed (partly fixed and partly volumetric) with fixed part less than 20% at national average consumption for household customer	11	FR, TH, HR, AT, MK, HU, UZ, XK, BG, SK, SA
3	Mixed (partly fixed and partly volumetric) with fixed part less between 20% and 50% at national average consumption for household customer	4	PL, CZ, BA, LT
4	Mixed (partly fixed and partly volumetric) with fixed part less more than 50% at national average consumption for household customer	2	GR, LV
Total		36	

TABLE 18: *Grouping System, distribution for Area J: network tariff structure (N=36)*

THE ECONOMICS OF VOLUMETRIC VS. FIXED NETWORK TARIFFS

The economic rationale for shifting network tariffs away from pure volumetric recovery is grounded in cost-reflectivity. Network costs – the depreciation and maintenance of cables, transformers, and substations – are primarily fixed: they do not vary meaningfully with the volume of energy transmitted at any given point in time. A household that consumes 1,000 kWh per year and a household that consumes 3,000 kWh per year impose essentially the same cost on the local network, provided they have the same peak demand profile and are connected at the same voltage.

Recovering these fixed costs through a volumetric charge, therefore, introduces a structural cross-subsidy from high-consumption to low-consumption users – and creates a perverse dynamic in an era of energy efficiency and distributed generation: the more customers reduce their consumption (whether through efficiency, solar panels, or heat pumps), the higher the per-unit network charge must rise to recover the same total revenue.

This dynamic is already visible in several ERRA member systems, where rapid growth in rooftop solar and the electrification of heating are compressing volumetric revenues without reducing the network investment needed to accommodate bidirectional flows and peak demand. The regulatory response – shifting more costs to fixed or capacity-based charges – is not primarily a technical preference but an economic necessity for the long-run sustainability of network revenue recovery.

¹⁵With NEPRA decision dated 11.02.2026 has applied a small fixed charge on households which remains under 20%.

An additional cost-reflectivity argument applies even in systems where the energy transition is still nascent: seasonal or occasional users – such as second homes, holiday properties, and seasonally occupied commercial premises – consume little energy but maintain a permanent grid connection. A purely volumetric tariff systematically under-recovers from these users, shifting their share of fixed network costs onto year-round, higher-consumption households. A fixed connection charge, proportional to the contracted power or connection capacity, would address this structural distortion regardless of the level of renewable penetration.

THE CURRENT DISTRIBUTION: REFORM PRESSURE AND PATH DEPENDENCE

The concentration of 16 members in Group 1 – fully volumetric – reflects both the recency of tariff unbundling in many jurisdictions (where separating the network charge from the overall electricity bill is itself a recent achievement) and the political economy of tariff reform. Shifting from a volumetric to a fixed or capacity-based network charge is distributionally contentious: it raises the effective cost for low-consumption households (who benefit disproportionately from volumetric recovery when they consume little) and reduces it for high-consumption users. In contexts where affordability and social equity are paramount policy concerns, this transition requires careful design of exemptions, progressive structures, or complementary social transfers.

The Group 2 cluster (11 members, 31%) – where a modest fixed or capacity element exists but remains below 20% of the bill at average consumption – represents systems where the policy direction is established, but the reform is partial. Many of these members have adopted a standing charge (a fixed monthly or annual fee) that covers administrative costs, while the bulk of network cost recovery remains volumetric. This design provides a foundation for further reform without the distributional disruption of a full shift.

THE ADVANCED CONFIGURATIONS

Poland, the Czech Republic, Bosnia and Herzegovina, and Lithuania (Group 3) have implemented tariff structures where the fixed or capacity component represents 20–50% of the network bill at average consumption – a level sufficient to ensure meaningful cost-reflectivity while maintaining a significant volumetric signal (which still serves functions in demand management and efficiency incentives). These systems have generally moved to power-based or contracted-capacity charges as the primary fixed element, supplemented by an energy component.

At the frontier, Greece (RAE/HEDNO) stands as the most advanced configuration in the ERRA membership: the electricity distribution tariff (DUOS) for household customers recovers approximately 90% of network costs through a capacity-based charge and only 10% through an energy component. This structure – which HEDNO has progressively implemented across multiple tariff reviews – directly reflects the cost structure of the Greek electricity system, where capacity commitment and voltage-level connection are the primary drivers of network costs. Latvia (PUC) has likewise moved to a predominantly capacity-based distribution tariff, consistent with its Group 4 position under incentive regulation as well.

Box n.19 | Greece: The Capacity-First Distribution Tariff

Greece's electricity distribution network operator (HEDNO), regulated by RAAEY, applies a household network tariff that exemplifies the cost-reflective logic of capacity-based network structure: approximately 90% of network costs are recovered through a capacity-based charge (in €/kW of contracted power or equivalent), with only 10% through a volumetric energy component.

The tariff is structured through the Distribution Use of System (DUoS) charge, differentiated by voltage level (35 kV, 10 kV, 0.4 kV). For household customers on the low-voltage network, the effective split between capacity and energy components was approximately 90%/10% as of 2025, based on data reported in RAE's annual tariff decisions.

Average household consumption in Greece is approximately 3,750 kWh/year, with total network expenditure ranging from €100 to €205/year depending on the meter type (single-phase vs. three-phase). No block-consumption or time-variant tariffs are currently applied to standard household customers (a time-of-use component exists only for vulnerable customers). No specific discounts for prosumers or self-consumption on the network tariff are in place, though injection tariffs exist for distributed generation.

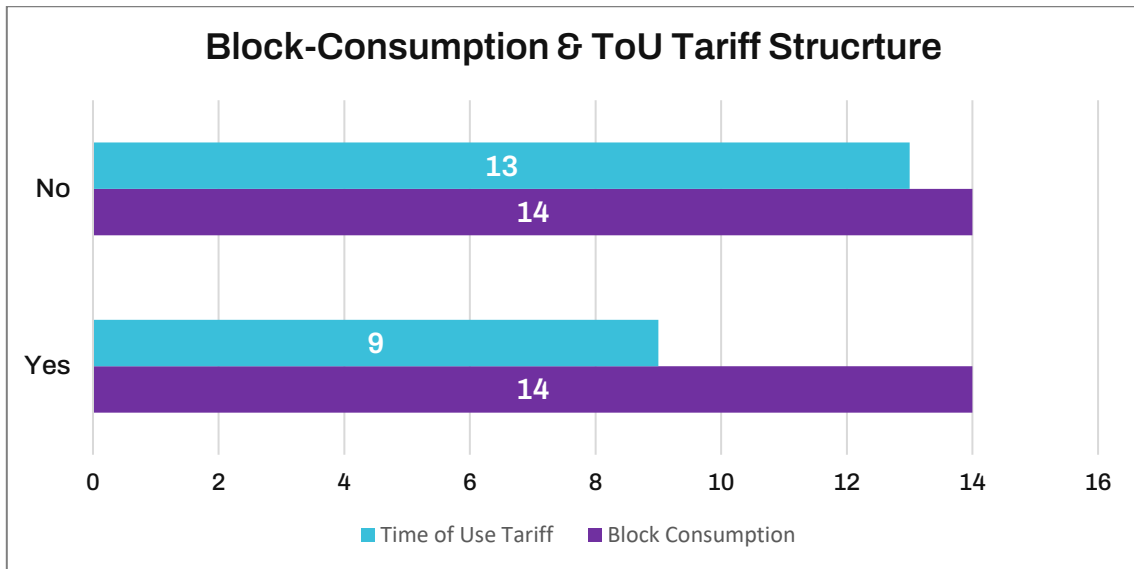
The Greek case illustrates that a predominantly capacity-based tariff is fully compatible with a competitive retail market and with significant distributed renewable generation, countering the common perception that such tariffs are difficult to implement outside vertically integrated systems.

BLOCK-CONSUMPTION TARIFFS AND TIME-OF-USE TARIFFS

Two additional structural features of the tariff landscape deserve specific attention.

Block consumption tariffs – applied as a network tariff component in several members with volumetric tariffs – tend to hinder the transition toward capacity-based structures. Their political appeal lies in appearing as a social protection instrument: lower unit charges for the first consumption block seem to protect lower-income households. In practice, however, the link between low consumption and low income is weak in both directions: large low-income families may have above-average consumption and derive little benefit from a block tariff, while small affluent households may consume little and benefit undeservedly. Block consumption tariffs therefore redistribute in ways that are not income-targeted and, by preserving the volumetric logic, create institutional inertia against capacity-based reform.

Time-of-Use (ToU) (or Time-variant) tariffs represent a structurally different case: rather than impeding the reform trajectory, the option to choose a ToU network tariff is a meaningful step forward for the energy transition, creating direct incentives for demand flexibility and load-shifting that are entirely consistent with a move toward capacity-based cost recovery. ToU tariffs require smart metering deployment (see Ch.5).



GRAPH 14: *Block-consumption tariffs and Time-of-use Tariffs among ERRA countries*

Box n.20 | **Mongolia: 2024 Block Tariff Reform**

In 2024, Mongolia's Energy Regulatory Commission (ERC) reformed the household electricity tariff system from a near-flat rate to a three-tier progressive block structure: a lower rate for consumption up to 150 kWh/month, a middle rate for 151–300 kWh, and a higher rate above 300 kWh. The reform was explicitly designed to change the subsidy regime, while preserving affordability at essential consumption levels, and to provide households with a price signal to monitor and contain electricity use. Reducing overall subsidies, this reform places Mongolia at the more advanced end of the Group 2 cluster – prices remain regulated, but the direction of travel is clearly.

CH.4 | SUMMARY OF KEY INSIGHTS

Area I: Regulatory Incentives to Grid Operators: A Solid Baseline, a Frontier Still Open

The ERRA membership has broadly converged on a functional model of incentive regulation – but one that is, for the majority of members, still anchored to service-quality indicators and has not yet extended to capital expenditure or the broader output demands of the energy transition.

The survey demonstrates the genuine diffusion of a regulatory model, operating price-cap or similar mechanisms on Opex combined with SAIDI/SAIFI-based incentives. that is workable across very different institutional and infrastructure contexts. An important part of ERRA members have moved beyond this baseline: capex incentives and broader output indicators) and full Totex frameworks with business-plan regulation.

Area J: Network Tariff Structure: The Most Consequential Reform Agenda

Network tariff structure is the area of greatest urgency for reform across ERRA's membership.

Most members remain with a fully volumetric tariff that recovers network costs entirely through energy consumed – a design increasingly misaligned with the economics of networks that are

primarily fixed-cost infrastructures. A growing minority has moved toward mixed structures, but only two members have adopted structures where the fixed or capacity component exceeds 50% of the network tariff expenditure for the average household bill.

The geographic concentration of higher-group members in Europe, and the persistence of fully volumetric tariffs across Central Asia, the Middle East, and much of Sub-Saharan Africa, does not reflect a simple developmental lag. It reflects path dependence: the volumetric tariff was designed for a world of growing consumption and vertically integrated utilities, and reforming it is distributionally contested in any context where low-income household protection is a live policy concern.

CH.4 | IMPLICATIONS FOR ERRA MEMBERS

For Members Seeking to Strengthen Regulatory Incentives to Grid Operator (Area I)

The landscape of Area I suggests three practical policy directions for ERRA members at different stages of development:

For members in Group 0–1: The priority is to establish a credible price-cap framework for Opex and a minimum-quality monitoring system based on SAIDI and SAIFI. The data infrastructure required for incentive regulation – rules for recording interruptions and classifying them by location and cause, and a data collection system from DSOs to the Regulator— is a prerequisite that should be developed *a priori* or in parallel with the regulatory incentive mechanism. Penalty-only frameworks are a pragmatically sound starting point, reducing the regulator's financial risk of miscalibrated targets.

For members in Group 2: The critical next step is to extend the incentive logic to capital expenditure, moving from cost-plus investment approval to output-referenced capex regulation. This does not require a full Totex framework; an intermediate step – such as benchmarking capex against company peers or against a reference network model – can reduce the capex bias inherent in pure Opex price-caps without requiring business-plan-level negotiation.

For members in Group 3: The leading question is whether to formalise the Opex–Capex boundary into a Totex methodology and introduce explicit incentives for non-wire alternatives (demand flexibility, storage, and distributed resources as substitutes for network investment). The French model – creating a contractualisation incentive for DSOs – offers a workable template that is compatible with EU regulatory frameworks and adaptable to markets with less developed flexibility markets.

For Members Seeking to Strengthen Regulatory Incentives to Grid Operator (Area J)

The reform agenda for network tariff structure is substantial and has a clear direction across ERRA's membership, even if the pace and sequencing will vary widely. Three practical observations emerge from the comparative mapping:

The volumetric legacy is a shared challenge, not a local deficiency. The 16 members in Group 1 span every region in ERRA's membership, including well-established EU regulatory jurisdictions.

Reforming a volumetric tariff does not require a single model: the right balance between fixed and volumetric components depends on the cost structure of each network, the distributional policy environment, and the maturity of demand flexibility

Capacity-based charges are equitable even before the energy transition arrives. The economic case for moving away from a purely volumetric tariff is not contingent on high levels of renewable penetration or prosumer activity. The network is a fixed-cost infrastructure, and recovering fixed costs through volumetric charges is structurally inequitable to the extent that it under-recovers from low-consumption or occasional users – including households in tourism-dependent economies with significant seasonal or second-home consumption patterns. This argument applies across all ERRA member contexts.

Capacity-based tariff reform is facilitated by companion social policy measures. Shifting from volumetric to fixed or capacity-based charges raises the effective cost for the lowest-consumption households, who are often also the lowest-income. Tariff reform in this area is therefore best designed in conjunction with targeted social protection measures – such as social tariffs, exemptions on the fixed component for below-threshold consumption, or complementary cash transfers – that insulate vulnerable consumers from the distributional effects of cost-reflective pricing. Several ERRA members with advanced tariff structures have implemented parallel mechanisms for vulnerable and low-income customer categories.

CHAPTER 5 | RENEWABLES, DIGITALISATION AND ELECTRIFICATION OF POWER SYSTEMS

AREA K: RENEWABLES DEVELOPMENT

THE IEA CLASSIFICATION

The shift in electrical systems driven by the rapid growth of renewable energy represents one of the most significant structural changes in modern power-sector regulation. However, in line with the goals of this Mapping exercise, the focus is not on assessing ambition or policy choices but on categorising the structural conditions faced by regulators. To create the analytical framework, we adopt the System Integration Phases developed by the International Energy Agency (IEA), which categorise power systems by the extent to which variable renewable energy (VRE) influences operations.

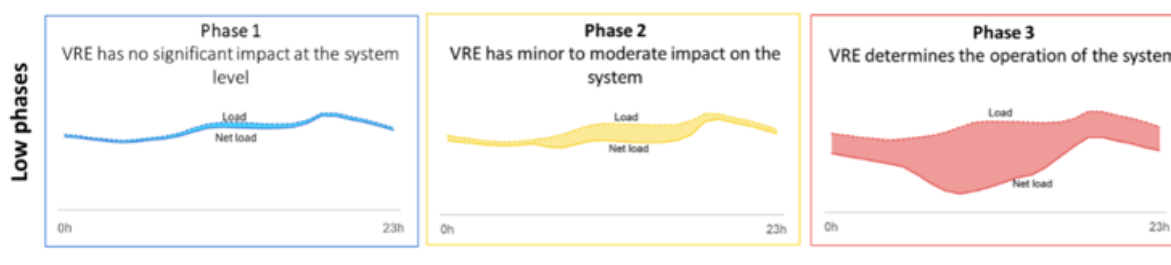
The IEA framework outlines successive phases of renewable energy integration, from initial penetration with minimal operational effects to advanced stages that require structural changes to market design, balancing mechanisms, and network infrastructure.

	Phase 1	Phase 2	Phase 3	Phase 4
Characterization from a system perspective	VRE as a non noticeable load at system level	VRE becomes noticeable at the system level to the SO	Flexibility is becoming relevant with greater swings in the supply/	Stability is becoming relevant. VRE covers significant share of demand at certain times

TABLE 19: Extract from Table 3.1 “Operational issues relevant to different phases of VRE development”, IEA, Status of Power System Transformation, 2017

For the first three phases, the “residual load” is used to illustrate the intensity of VRE penetration.

IEA framework guides a phased introduction of integration measures



GRAPH 15: Residual loads as indicator of Phases 1-2-3 of IEA Classification

LANDSCAPE OF RENEWABLES DEVELOPMENT

For the ERRA Mapping exercise, these integration phases are divided into a five-level classification system (Groups 0–4), following the methodological approach used in earlier sections of this report.

In this interpretation:

- Lower groups (0–1–2): Renewable penetration remains limited or moderate. System operation remains primarily driven by dispatchable generation, and integration challenges are manageable within existing operational frameworks.
- Intermediate group (3): Renewable penetration begins to shape system dynamics. Increased balancing needs and flexibility requirements emerge, and VRE materially influences dispatch patterns.
- Higher group (4): Renewable penetration becomes structurally dominant at times. System stability, adequacy design, and market rules require adaptation to accommodate high shares of variable generation.

The distribution across groups illustrates the diversity of renewable integration levels among ERRA members.

GROUP	K. Renewables	N. of ERRA members	ISO country codes
0	No renewable development yet	0	–
1	IEA Phase 1 – VRE has no significant system-level impact	9	AZ, KG, TH, AL, CM, MZ, KZ, DZ, BS
2	IEA Phase 2 – Net load variations noticeable; moderate system impact	10	GE, BA, HR, UZ, MN, NG, XK, SK, SA, OM
3	IEA Phase 3 – VRE materially influences system operation; flexibility needs increase	17	PL, GR, CZ, TR ¹⁶ , PK, FR, LT, MD, MK, HU, AM, AE, EE, BG, RO, UA, LV
4	IEA Phase 4+ – High penetration; structural adaptation required	1	AT
Total		37	

TABLE 20: *Grouping System, distribution for Area K: Renewables development (N=37)*¹⁷

A total of 19 jurisdictions fall within the lower integration tiers (Groups 1–2). In these systems, renewable penetration remains limited or has only a moderate operational impact.¹⁸ System balancing continues to rely primarily on dispatchable generation, and renewable output has not yet

¹⁶ Depending on generation profiles and consumption patterns, Türkiye does at times experience conditions closer to Group 4

¹⁷ For Ukraine, data for 2022–2024 are not publicly available due to martial law restrictions

¹⁸ However, the VRE expansion can be significant even in Group 2: for instance in Oman the share of renewable energy increased from 1.95% in 2021 to 9.46% in 2025.

significantly altered system operating patterns. Integration challenges at this stage can generally be accommodated within existing operational and regulatory frameworks.

Seventeen members are classified in the intermediate tier (Group 3). In these systems, renewable generation has reached levels that begin to influence system operation and dispatch patterns. Net-load variability becomes more pronounced, increasing the need for additional system flexibility through mechanisms such as balancing arrangements, storage, interconnections, or demand-side response.

Only one jurisdiction (Austria) is classified in the higher integration tier (Group 4), where renewable penetration is sufficiently high to require structural adaptation of system operation. At this stage, renewable generation can cover a large share of demand at certain periods, raising additional considerations for system stability, balancing arrangements, and market design. Overall, the results confirm that renewable integration across ERRA members remains heterogeneous, with most jurisdictions positioned in early or intermediate stages of renewable system integration.

RENEWABLE PENETRATION TRENDS (EMBER DATA)

To complement the structural classification presented above, quantitative indicators based on Ember electricity data were analysed. These indicators provide a snapshot of renewable penetration levels and their evolution over time across ERRA members.

Two metrics were calculated for each jurisdiction:

Renewable coverage of electricity demand:

$$RES \text{ coverage demand} = \frac{\text{Generation RES}}{\text{Total Electricity Demand}}$$

The renewable category includes wind, solar, hydro, bioenergy, and other renewable sources, consistent with the Ember dataset.

This indicator expresses the share of total electricity demand covered by RES-sourced generation in a given year.

VRE coverage of electricity demand:

$$VRE \text{ coverage demand} = \frac{\text{Generation VRE}}{\text{Total Electricity Demand}}$$

The VRE (Variable Renewable Energy) category includes only wind and solar, consistent with the Ember dataset. This indicator expresses the **share of total electricity demand covered by VRE-sourced generation in a given year**.

In the following paragraphs, for each indicator, to illustrate the development trajectory, the analysis compares the first available observation year (typically 2019) with the most recent year in the dataset (typically 2024), enabling identification of “expansion” in RES/VRE penetration over time.

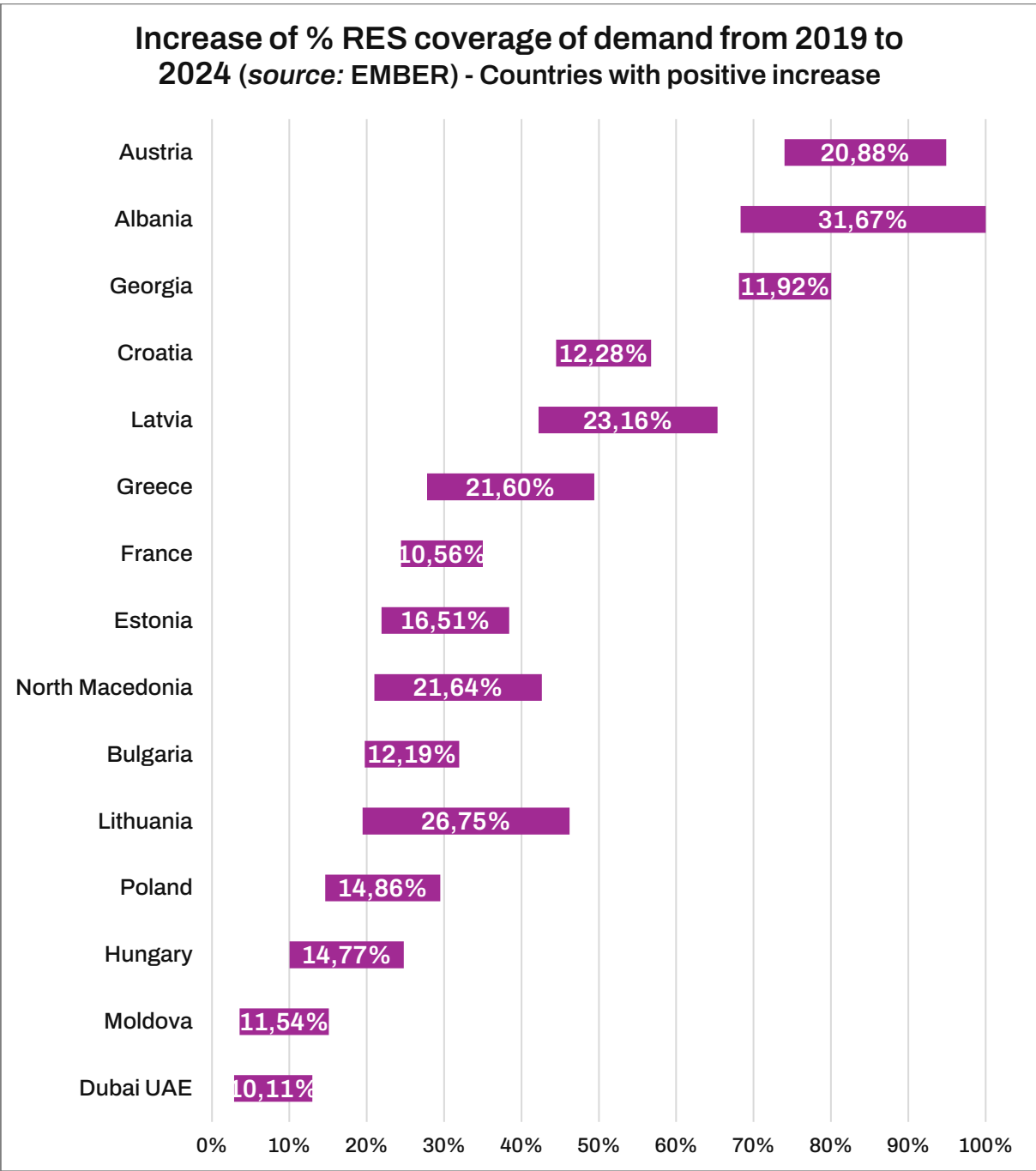
INCREASE OF RES COVERAGE OF ELECTRICITY DEMAND FROM 2019 TO 2024

The evolution of renewable penetration was further analysed by comparing the share of renewable electricity in demand coverage between 2019 and 2024 using Ember electricity data. The figure focuses on jurisdictions where renewable coverage of electricity demand increased by more than 10 percentage points over the observed period.

The results indicate substantial RES expansion in several ERRA members. The largest increases in renewable coverage of electricity demand from 2019 to 2024 are observed in Albania (31.67%), Lithuania (26.75%), Latvia (23.16%), North Macedonia (21.64%), Greece (21.60%), and Austria (20.88%). Significant growth is also recorded in Estonia (16.51%), Poland (14.86%), Hungary (14.77%), and Bulgaria (12.19%). Additional increases above ten percentage points are observed in Georgia (11.92%), Moldova (11.54%), France (10.56%), and the United Arab Emirates (10.11%).

Overall, these results illustrate that the share of electricity demand covered by renewable penetration has expanded across a diverse group of ERRA members, although the magnitude of change varies significantly between jurisdictions.

It is important to note that this indicator captures overall renewable development, including technologies such as hydropower and bioenergy. In many systems, particularly those with reservoir-based hydropower, renewable generation can be dispatchable and therefore contributes positively to system balancing. As a result, the overall renewable penetration indicator primarily reflects the structural sustainability of electricity supply, rather than the operational challenges associated with renewable integration.



GRAPH 16: Change in renewable coverage of electricity demand between 2019 and 2024;¹⁹ all renewable sources included (source: Ember).

¹⁹ Data availability in the Ember dataset varies across jurisdictions. For Albania, Mozambique, and Cameroon, data are available up to 2023. For Ukraine and the Bahamas, data for 2023–2024 are not available. In these cases, the increase is calculated between the first and most recent observation years.

INCREASE OF VRE COVERAGE OF ELECTRICITY DEMAND FROM 2019 TO 2024

Operational challenges related to renewable integration are more closely linked to variable renewable energy (VRE) sources, particularly solar and wind generation, whose output fluctuates depending on weather conditions.

To better capture this dimension, a separate analysis was conducted focusing specifically on solar and wind generation, excluding other renewable technologies such as hydropower or bioenergy. For these technologies, the coverage of electricity demand and its evolution between 2019 and 2024 were calculated separately.

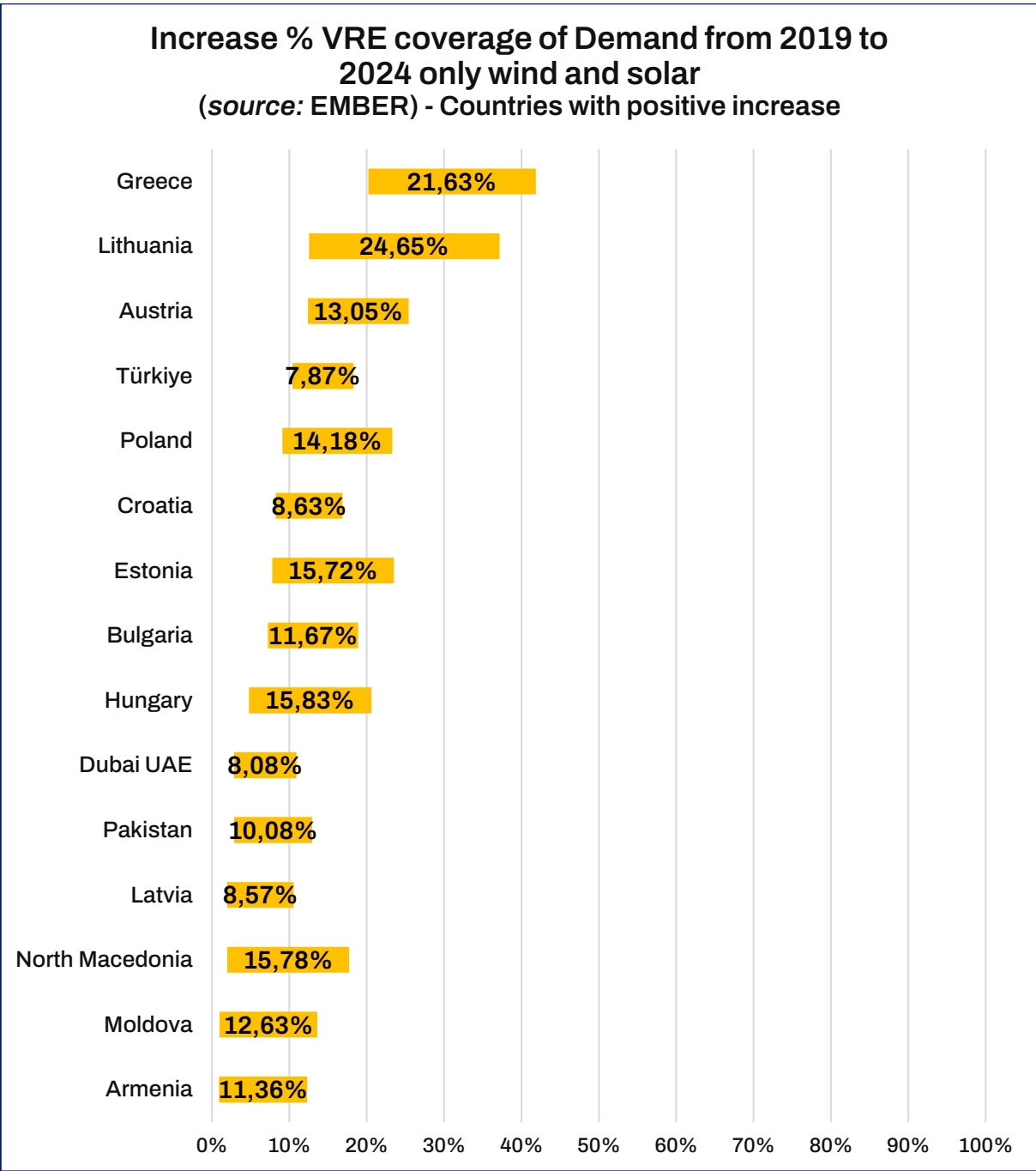
The underlying technology trends also illustrate the rapid expansion of variable renewable generation in several ERRA member jurisdictions. In Austria, solar generation increased from 1.70 TWh in 2019 to 8.82 TWh in 2024, reflecting strong photovoltaic deployment over the analysed period. A similar pattern can be observed in Hungary, where solar generation expanded from 1.40 TWh to 7.70 TWh.

Significant solar growth is also evident in Poland, where solar generation increased from 0.71 TWh in 2019 to 15.23 TWh in 2024. At the same time, Poland experienced continued expansion in wind generation, which grew from 15.11 TWh to 24.82 TWh during the same period. Comparable developments are observed in Greece, where solar generation increased from 4.43 TWh to 11.26 TWh.

These examples demonstrate how the expansion of solar and wind technologies increasingly shapes the renewable energy landscape across several ERRA members.

Overall, the analysis shows that renewable electricity deployment across ERRA members is progressing at different speeds and through different technology portfolios. While the Area 9 grouping reflects the structural stage of renewable integration in power systems, the quantitative indicators based on Ember data illustrate the recent dynamics of renewable growth.

The distinction between overall renewable penetration and variable renewable energy (solar and wind) is particularly important. Systems with high shares of dispatchable renewable generation, such as hydropower, may demonstrate strong renewable coverage of demand while facing fewer operational challenges. In contrast, the expansion of solar and wind generation introduces additional variability into the system and therefore increases the need for flexibility resources, balancing arrangements, and system adaptation.



GRAPH 17: Change in Variable Renewable Energy coverage of electricity demand between 2019 and 2024;²⁰ only solar and wind considered (source: Ember)

Taken together, the results confirm that renewable development among ERRA members remains heterogeneous, reflecting different stages of energy transition, technology deployment patterns, and power system characteristics.

²⁰ Data availability in the Ember dataset varies across jurisdictions. For Albania, Mozambique, and Cameroon, data are available up to 2023. For Ukraine and the Bahamas, data for 2023–2024 are not available. In these cases, the increase is calculated between the first and most recent observation years.

Box n.21 | **Moldova: Capacity Non-Utilization Fee**

In Moldova, unused grid connection permits became a significant obstacle to renewable energy development. By early 2024, the transmission system operator Moldelectrica had issued permits for approximately 1,500 MW of new generation capacity, yet less than 10% of that was being commissioned annually. Many permits had been obtained speculatively, effectively blocking grid access for genuinely committed investors.

To address this, the government approved amendments to the Law on Electricity (No. 107/2016) in February 2025, introducing a mandatory financial guarantee for any project above 200 kW requesting a grid connection permit. The guarantee is fully refunded if the plant is built and commissioned within the agreed deadline. If it is not, the developer forfeits the guarantee: under the previous regime, a penalty of 50–70% of the guarantee amount was transferred to the state budget. As of 30 June 2025, this was replaced by a fixed forfeit of 1,000 MDL/kW (approximately €50/kW), now retained directly by the grid operator and earmarked for network modernisation.

A transition period was granted until 30 June 2025, during which holders of pre-existing permits could voluntarily return them without penalty. Thirty permits were returned as a result, releasing over 109 MW of previously locked-up capacity across Moldelectrica, Premier Energy Distribution, and RED Nord. The Moldovan regulator (ANRE) implemented the capacity non-utilization fee building on the underlying connection regulation (ANRE Decision No. 169/2019), in conjunction with the new legislative amendment.

Box n.22 | **Ukraine: Building Guarantees of Origin Market**

Ukraine's launch of a Guarantees of Origin (GO) registry for renewable electricity in August 2024 stands out not only as a regulatory milestone but as a remarkable act of institutional resilience: the system was built and activated while the country's energy infrastructure was under sustained military attack. NEURC, the Ukrainian energy regulator, is responsible for the issuance, transfer and cancellation of GOs, and within the first year of operation the registry recorded over 1,500 registered production units and more than 16 million certificates issued and traded across two platforms. Guarantees of Origin certify that a given quantity of electricity was produced from renewable sources, allowing buyers – whether industrial consumers, suppliers or traders – to make credible green energy claims. Ukraine was one of the first countries in the Energy Community to operationalise such a scheme, and since October 2025, cross-border transfers have become possible within the Energy Community Contracting Parties. Ukraine's strategic goal is full integration into the Association of Issuing Bodies (AIB) Hub, which would enable mutual recognition of GOs with EU member states and open the door to international green electricity trade – a step that NEURC regards as essential both for the energy transition and for the country's deeper integration into the European energy market.

Box n.23 | **Flexible grid connection services: a new regulatory framework for renewables in Latvia**

Latvia's electricity transmission grid has been under significant pressure from renewable energy developers. By early 2025, the volume of pending connection requests far exceeded available firm capacity, with large amounts of grid headroom effectively locked up by permit holders who had not yet commissioned their plants. Against this backdrop, the Latvian Parliament adopted amendments to the Electricity Market Law (in force 1 April 2025), introducing a structured non-firm connection framework at the transmission level.

The reform replaces a single "constant" connection model with three distinct types of transmission system service. Under the constant service, the TSO ensures uninterrupted injection up to the contracted capacity, subject only to statutory curtailment provisions. Under the flexible service, the TSO may curtail a producer's injection for up to 10% of the time (876 hours per calendar year). Under the limited service – reserved primarily for storage facilities – the TSO may curtail at any time and in any volume necessary for system reliability, with no annual cap, and connection permits may be issued beyond the free capacity available in the system at the time of application.

A financial security deposit is required from producers (or storage facilities) requesting a constant service connection (for installations above 50 kW), with the deposit amount determined by the Latvia Public Utilities Commission (PUC); the deposit is refunded once the generation unit is connected to the system. Producers who had previously reserved capacity under the old regime were granted a window to return unused permits voluntarily and have their reservation fees refunded.

The practical impact was immediate: following the reform, over 109 MW of previously blocked transmission capacity was released back to the grid through voluntary permit returns, making it available for new projects.

The Public Utilities Commission implemented two regulations to operationalise the framework: one establishing the detailed rules for curtailment procedures, accounting, and the compensation mechanism applicable when curtailment exceeds 876 hours; the other governing the procedure according to which an electricity producer receiving a flexible transmission system service may change the existing transmission system service to a constant transmission system service.

Latvia's renewable buildout provides the context for the reform's urgency. As of 2024, RES covered 45.5% of gross energy consumption – up 8 percentage points over five years – but Latvia remains well short of its 2030 NECP target of 62%. Solar capacity stands at 0.66 GW against a 1.2 GW target; onshore wind at 0.13 GW against 1.5 GW, with a further increase by 0.8–1 GW in the generation capacity. Unlocking grid access efficiently is therefore a precondition for meeting national climate commitments, and the flexible transmission system service framework is Latvia's principal regulatory response to that challenge.

GEOGRAPHICAL DISTRIBUTION

The geographic dimension of renewable integration reveals a predictable core pattern alongside some notable exceptions. EU members are heavily concentrated in Group 3, reflecting both the operational maturity of interconnected European power markets and the sustained wind and solar expansion driven by EU policy frameworks. Also among non-EU European members, 4 out of 7 are in Group 3, a sign that energy transition reaches beyond UE borders.

The Caucasus and Central Asian regions show the widest within-region spread: Armenia and the UAE/Dubai (in the Gulf group) reach Group 3, while Azerbaijan, Kyrgyzstan, and Kazakhstan remain at Group 1, reflecting their continued reliance on fossil-fuel dominated generation.

Region	No.	Group 1	Group 2	Group 3	Group 4
EU	13		2	10	1
Other Europe non-EU	7	1	2	4	
Caucasus	3	1	1	1	
Middle East & Gulf	3		2	1	
Africa	4	3	1		
Central Asia	3	2	1		
Rest of World	4	2	1	1	
TOTAL	37	9	10	17	1

TABLE 21: Number of members per region and per Renewable development groups (N=37, Egypt N/A)

AREA L: SMART METERING

Smart metering is the foundational digital infrastructure of the modern electricity system. By enabling granular, real-time measurement of consumption, smart meters make it possible to introduce time-of-use tariffs, activate demand-side flexibility, monitor grid conditions at distribution level, and engage prosumers in the energy market. The deployment status of smart meters therefore determines the practical ceiling for a wide range of regulatory innovations in retail markets and network management. This regulatory area maps the current position of ERRA members along the deployment curve, from systems where metering coverage itself remains incomplete to those where near-universal rollout has been achieved and policy attention has shifted to data governance and service quality.

THE LANDSCAPE OF SMART METERING

The grouping system for Area L classifies members according to the share of customers equipped with smart meters, from Group 0 (significant populations still unmetered) to Group 4 (more than 90% smart meter penetration). The classification captures the deployment milestone rather than the functional depth of metering: advanced capabilities such as two-way communication, 15-minute interval data, or integration with flexibility platforms are reflected in the qualitative analysis rather than the group assignment.

GROUP	L. Smart metering	N. of ERRA members	ISO country codes
0	Still several electricity users supplied without any meter	0	-
1	Only traditional meters (no smart meters)	7	CZ ²¹ , TR ²² , TH, MD, CM, MZ, BS
2	More than 10% of smart meters installed	18	PL, GR, GE, AZ, BA, KG, PK, HR, AL, MK, HU, KZ, DZ, NG, XK, RO, UA, BG
3	More than 50% of smart meters installed	5	LT, AM, MN, SK, OM
4	More than 90% of smart meters installed	7	FR, AT, UZ, AE/Dubai, EE, SA, LV
Total		37	

TABLE 22: *Grouping System, distribution for Area L: smart metering (N=37)*

The distribution across groups reveals a continuum in the ERRA membership between jurisdictions that have achieved – or are close to achieving – near-universal smart meter deployment, and those still in the early or intermediate stages of rollout.

Seven jurisdictions are classified in Group 4 (more than 90% of customers with smart meters): France, Austria, Uzbekistan, the UAE (Dubai), Estonia, Saudi Arabia, and Latvia. This is a geographically and economically diverse group that defies simple categorisation: it includes EU member states with long-established metering programmes alongside Gulf economies and Central Asian systems that have invested heavily in metering infrastructure as part of broader utility modernisation strategies. France completed the deployment of its Linky smart meter (34 million units with Enedis by the end of 2021, reaching 96% coverage by March 2025); Austria achieved approximately 97% penetration by the end of 2024; Uzbekistan reports 100% smart meter coverage.

Among Group 4 members, Latvia offers a noteworthy example of early-mover implementation. The decade-long phased rollout by Latvian DSO (Sadales tīkls) achieved full system coverage while allowing procurement and operational practices to adapt over time, ensuring a balanced use of workforce capacity across installation cycles. Latvian regulatory experience of smart metering roll-out illustrates that a sustained, efficiently managed programme can deliver universal coverage with the added flexibility of incorporating more advanced functionalities as successive meter generations are deployed

Five jurisdictions are in Group 3 (more than 50% deployed): Lithuania, Armenia, Mongolia, Slovakia and Oman. These systems have crossed the majority threshold but have not yet achieved full coverage. In Lithuania, smart meter deployment is advancing in line with EU regulatory requirements.

²¹ In Czechia, roll-out is currently focused on consumers with annual consumption of more than 6 MWh and is expected to be completed by the end of Q2 2027. This will lead to deployment for 14.2% of consumers and 60.9% of electricity consumption by the end of Q2 2027.

²² In Türkiye, the penetration of smart meters remains below 10% due to the substantial installed base; however, smart meters are indeed present.

In Slovakia, deployment is proceeding under a national decree but remains below 25% in some distribution zones.

The largest single group is Group 2 (more than 10% deployed), comprising 17 jurisdictions. This reflects the reality that many ERRA members – including EU economies such as Poland, Romania, Hungary, and Croatia – have begun rollout programmes but deployment remains partial, often conditioned on phased timelines or positive cost-benefit analyses required under EU law. Several Caucasus and Balkan members are also at this stage, reflecting emerging metering programmes that are still in their early implementation phases.

Six jurisdictions – the Czech Republic²³, Türkiye, Thailand, Moldova, Mozambique, and the Bahamas – remain in Group 1: only traditional meters are deployed, with limited smart meter penetration. In some cases (the Bahamas, Mozambique), universal metering itself has not yet been fully achieved. In Türkiye, smart meter rollout has not been mandated at scale, though pilot programmes exist. The Bahamas has announced plans for a universal rollout of smart meters.

Box n.24 | **Uzbekistan: Smart Metering Complete Roll-Out (Electricity and Gas)**

Uzbekistan is one of the leading countries in the world in the roll-out of smart meters. Whereas, as of 01.01.2021, 80% of smart meters were installed throughout the country, by 31.12.2024, 100% of electricity consumers were equipped with smart metering devices. A single data processing centre was commissioned in 2020, and software capable of operating 8 mln consumers was installed, with a possibility to expand to 20 mln. The main feature of Uzbekistan's tariff system is the mandatory prepayment for electricity supply through smart meters for all consumer categories. Smart meters also allow for the option of using time-of-use tariffs.

Uzbekistan also completed the roll-out of smart meters in the natural gas sector in accordance with the CMRU Decree No. 594, dated 28.09.2020.

Box n.25 | **Lithuania's Smart Metering Programme: A Full-Function Deployment**

Lithuania's smart meter rollout, launched in 2022, has reached approximately 1,250,000 units installed by mid-2025, covering around 62% of all households and 94% of businesses. A second phase, targeting low-consumption households, is scheduled to continue from 2026 as older meters reach the end of their metrological certification period. What makes the Lithuanian programme particularly noteworthy is not just its pace but the breadth of functionalities activated. The deployed meters support near-real-time data access at 15-minute intervals, bilateral communication between the meter and the network, remote connection and disconnection, support for time-of-use tariff plans, active and reactive

²³ Smart meter roll-out in Czechia is based on the national action plan for smart grids, which was updated in 2025 for the period until 2030. 365 000 smart meters have been installed thus far, with a goal of installing 1 867 000 by 2030. Roll-out is currently focused on consumers with annual consumption of more than 6 MWh and is expected to be completed by the end of Q2 2027. This will lead to deployment for 14.2% of consumers and 60.9% of electricity consumption. Czechia will carry out a cost-benefit analysis on expanding nationwide roll-out of smart meters to consumers with annual consumption below 6 MWh by the end of December 2028. Consumers with annual consumption below 6 MWh may also request free smart meter installation from their DSO if they require such a device as part of energy sharing, flexibility provision or a third-party storage operation. Consumers outside this framework may request the installation of a smart meter from their DSO, but they bear the cost of the installation.

energy measurement – including energy fed back to the grid by prosumers with solar installations – and encrypted secure data transmission with built-in fraud detection. An optional P1 consumer interface additionally allows households to monitor their consumption in near-real time without any intermediary. Taken together, the Lithuanian deployment is a close practical match to the minimum functionality requirements set out in Annex II of the EU Electricity Directive (2019/944), which obliges Member States rolling out smart meters to ensure, among other things, real-time consumption data, time-differentiated tariff support, remote access capability and two-way communication.

For ERRA members designing or upgrading their own metering framework, this would be a useful reference point.

Box n.26 | **United States - Smart Metering**

In 2022, U.S. electric utilities had approximately 119 million advanced metering infrastructure (AMI) installations, equivalent to roughly 72% of total electricity meter installations – an average penetration level broadly comparable to Group 3 in the ERRA classification. Residential customers accounted for about 88% of total AMI installations, with approximately 73% of all residential electric meters equipped with AMI.

While in the EU framework smart meter rollout is anchored in a regulatory obligation tied to a cost-benefit analysis (CBA), deployment of smart metering in U.S. has been driven primarily by utility investment decisions, approved within state-level regulatory proceedings (typically including CBA), but without a nation-uniform mandate. This structural difference explains both the scale achieved and the geographic unevenness of coverage: penetration varies considerably across states and utility types, with smaller utilities and rural service territories typically lagging behind.

The U.S. Energy Information Administration (EIA) has tracked AMI installations by utility, state, sector, and balancing authority since 2013 via Form EIA-861 – one of the most granular longitudinal datasets on smart metering deployment available globally. The most recent data are available for 2024.

Data shared with ERRA by NARUC (National Association of Regulatory Utility Commissioners). Source: EIA, October 2023; Form EIA-861. <https://www.eia.gov/electricity/data/eia861/>.

NARUC Regulator’s Financial Toolbox for Advanced Metering Infrastructure: <https://pubs.naruc.org/pub/4DE49EE6-1866-DAAC-99FB-B36D6E27919D>.

AREA M: ELECTRO-MOBILITY

Electric mobility is emerging as one of the most significant new demand categories for electricity systems, with implications for distribution network loading, peak demand management, tariff design, and the potential to contribute to system flexibility through vehicle-to-grid technologies. The pace of EV adoption and the adequacy of charging infrastructure are therefore regulatory concerns that extend well beyond transport policy. This regulatory area maps the state of electro-mobility development across ERRA members, capturing both the expansion of the EV fleet and the deployment of publicly accessible charging infrastructure over the past three years.

THE LANDSCAPE OF ELECTRO-MOBILITY

The grouping system for Area M assesses recent momentum rather than stock: it focuses on developments over the last three years, and in particular on whether EV growth and charging infrastructure expansion are advancing in a balanced way. A jurisdiction may score Group 3 not because its EV fleet is small, but because charging point deployment has failed to keep pace with vehicle uptake – creating network adequacy concerns and barriers to adoption. Group 4 represents systems where both sides of the equation are developing in a coordinated and significant way.

In this area, in some countries, energy regulators are not sufficiently involved and they cannot provide any data.

GROUP	M. Electro-mobility	N. of ERRA members	ISO country codes
0	No significant e-mobility development	6	GR, CM, MZ, AM, XK, BS
1	In the last 3 years, limited e-mobility development	4	CZ, BA, MK, DZ
2	In the last 3 years, moderate e-mobility development (Both EVs and recharge points)	9	KG, HR, MD, MN, EE, NG, UA, SA, AL
3	In the last 3 years, significant e-mobility development but not balanced on recharge side (for instance not enough recharge points in respect of new EVs)	5	PL, AZ, HU, KZ, RO
4	In the last 3 years, significant e-mobility development and well balanced between new Evs and recharge points	10	GE, TR, FR, TH, LT, AT, UZ, AE, SK, LV
Total		34	

TABLE 23: *Grouping System, distribution for Area M: electro-mobility (N=34; PK, BG, EG, OM: N/A)*

Ten jurisdictions are classified in Group 4, the highest tier, signifying significant and well-balanced development of both EVs and public charging infrastructure over the last three years. The geographic breadth of this group is notable: it includes not only advanced European economies but also a Caucasus country (Georgia), a Southeast Asian economy (Thailand), a Central Asian member (Uzbekistan), and a Gulf state (UAE). In each case, active policy frameworks, regulatory involvement, and investment in charging infrastructure appear to have driven the balanced development the grouping system requires.

Five jurisdictions are in Group 3, characterised by significant EV growth but with charging infrastructure expansion that is not fully commensurate: Poland, Azerbaijan, Hungary, Kazakhstan, and Romania. In Poland and Hungary, EV registration numbers are rising rapidly, but the density of public charging points in secondary cities and rural areas lags behind. In Kazakhstan, significant EV fleet growth in the past three years has not been matched by equivalent charging network deployment outside major cities.

Nine jurisdictions are in Group 2, reflecting moderate, broadly balanced development: Croatia, Kyrgyzstan, Moldova, Mongolia, Estonia, Nigeria, Ukraine, Saudi Arabia, and Albania. Several of these members have small but growing EV fleets supported by an adequate (if limited) number of charging

points. Estonia's classification at Group 2 – rather than higher – reflects a recent deceleration in EV adoption growth, even as earlier deployment was more advanced.

The six Group 0 jurisdictions – Greece, Armenia, Kosovo*, Mozambique, the Bahamas and Cameroon – have not recorded significant e-mobility development in the observed period. In Armenia and Kosovo*, the absence of any structured regulatory or policy framework for EV charging is noted. Greece's Group 0 classification is the most striking, given its EU membership and relatively high per-capita income; it may partly reflect the survey period and specific market dynamics rather than a permanent structural condition.

KEY REGULATORY THEMES ACROSS ERRA MEMBERS

The mapping exercise surfaces three regulatory questions that recur across ERRA member contexts.

First, the role of DSOs in the roll-out of publicly accessible EV charging stations. Regulatory frameworks across the ERRA membership show three distinct models:

- countries where DSOs are explicitly prohibited from owning or operating charging points (typical EU model; for instance, Lithuania, where DSOs cannot own charging stations except for their own operational use, and competition among 47 charging operators is the result);
- countries where DSOs are functionally responsible for connecting and enabling charging infrastructure but do not operate the commercial charging service (Georgia, Romania);
- and countries where the regulatory boundary is still being defined.

The choice between these models has significant implications for the pace of infrastructure deployment and the development of competitive charging markets.

Second, the question of whether and how to regulate EV charging service prices. Several ERRA members have adopted a hands-off approach, treating EV charging as a competitive retail service outside the scope of regulation. Türkiye is notable for explicitly granting its regulator EMRA the authority to impose price caps on charging service providers for up to three months in cases of anti-competitive behaviour – a precautionary instrument that preserves market freedom while providing a backstop against market abuse. Other members (Georgia and typically EU countries) leave charging service fees entirely to market forces, with regulatory involvement limited to network connection conditions.

Third, the emerging regulatory challenge of balancing market and grid integration. EU Regulation 2023/1804 requires Member States to assess the impact of charging infrastructure on system flexibility, balancing markets, and renewable energy use. Lithuania was preparing this report during the mapping exercise. This regulatory obligation reflects a growing awareness that large-scale EV adoption is not just a retail market development but a system operation and planning challenge – connecting the electro-mobility regulatory agenda directly to the renewable integration and smart metering dimensions of this chapter.

Box n.27 | Georgia - Innovative Regulatory Framework for EV Charging

Georgia is classified as Group 4 in electromobility developments, the highest tier, reflecting significant and well-balanced growth in both EV uptake and public charging infrastructure in recent years. Georgia's regulatory framework for EV charging integrates the sector into the existing distribution network rules in a distinctive way.

The DSO bears full responsibility for connecting new facilities (including charging stations) at 0.4 kV and 6/10 kV – covering all works from network laying and equipment purchase to permits and metering installation. For publicly accessible charging stations not intended for personal use, NEWRC's Resolution N19 of June 2021 established that the standard connection fee is reduced by 50%. This incentive is designed to accelerate the deployment of public charging infrastructure by lowering the barrier to entry for charging station operators.

In the downstream market for charging services, regulation is minimal: fees between charging operators and EV users are set freely, without regulatory intervention. The "Law on Energy and Water Supply" explicitly excludes the sale of electricity from charging stations from its regulatory scope. This combination – regulatory responsibility for network connection with market freedom for charging services – has resulted in a competitive and expanding public charging market in Georgia.

Box n.28 | United States – A Federated E-Mobility Landscape

The United States offers a large-scale external reference point for electromobility development, operating under a federated model in which state-level regulators retain primary jurisdiction over EV charging policy while federal programs provide investment incentives. NARUC (National Association of Regulatory Utility Commissioners) coordinates regulatory engagement across this landscape at the national level.

On charging infrastructure, the U.S. Department of Energy tracks monthly growth in publicly accessible EV charging ports since 2021, with aggregated data available through December 2025 via the Alternative Fueling Station Locator. Location-specific data confirm that charging network density remains highly uneven across states, with dense coverage in California and the Northeast contrasting with sparser deployment in rural and interior regions.

On the policy side, the Atlas EV Hub State EV Summary Dashboard – which tracks EV sales, market share, charging ports, utility investment, enacted state policies, and proposed legislation – records 16 enacted EV-related state policies and approximately USD 194 million in state-level funding allocations as of the most recent data. Of this, the largest share is directed toward bus and transit fleet electrification (USD 150 million), followed by fueling infrastructure (USD 37 million), with the remainder distributed across system integration, light-duty vehicles, and administrative costs.

The U.S. case illustrates that significant investment in charging infrastructure can be mobilised through a decentralised, state-driven framework. At the same time, the federated model produces heterogeneity in technical standards, data collection, and grid integration requirements that ERRA members designing national frameworks for EV charging can usefully consider as a cautionary counterpoint alongside its deployment achievements.

Data shared with ERRA by NARUC (National Association of Regulatory Utility Commissioners). Sources: U.S. Department of Energy, Alternative Fueling Station Locator (<https://driveelectric.gov/stations-growth>).

CH.5 | SUMMARY OF KEY INSIGHTS

Area K: Renewables Development: Heterogeneity as the Structural Baseline

The mapping data confirm that renewable integration across the ERRA membership is not a single journey at different speeds, but a genuinely multi-dimensional landscape shaped by geography, resource endowment, market architecture, and policy choice – with no single trajectory representing the norm.

The most consequential finding is the concentration of members in Group 3 (17 jurisdictions), where variable renewable generation has already begun to shape system operations and is prompting the need for systematic flexibility. This concentration at the intermediate tier – rather than at either extreme – reflects a membership that is broadly in the midst of the integration challenge, not ahead of it or behind it. The regulators of these systems face the most immediate and operationally complex questions: how to manage increasing net-load variability, how to create adequate balancing mechanisms, and how to ensure that the grid investment cycle keeps pace with renewable deployment.

The distinction between overall renewable penetration and variable renewable energy (specifically solar and wind) proved analytically important. Several members – notably in the Caucasus, the Balkans, and Central Asia – show high overall renewable shares driven by dispatchable hydropower, while VRE integration challenges remain limited. Conversely, members with rapid solar and wind expansion (Poland, Hungary, Greece, Lithuania) face growing integration pressures even where their total renewable share is moderate. The IEA phase framework captures this distinction well: it is the operational impact on the system, not the aggregate share, that determines the regulatory challenge.

Areas L: Digitalisation and Smart metering

Smart metering has been considered in this Mapping exercise the most significant example of digitalisation of power systems. Deployment of smart metering systems across the ERRA membership is characterised by a continuum, from a near-universal rollout to many countries still managing the deployment challenge.

Seven members have reached Group 4 (above 90% penetration), and their diversity – spanning France, Austria, Estonia, Latvia, Uzbekistan, Saudi Arabia, and the UAE – makes a clear point: universal smart metering is achievable across very different institutional, economic, and geographic contexts. The rollout mechanisms may differ, but the outcome – near-complete metering coverage enabling real-time data collection and remote management – is comparable.

For the 18 members of Group 2 and the 7 of Group 1, the deployment challenge remains the primary concern. The data reveal that the main gating factor varies by context: in EU member states, it is the cost-benefit analysis requirement embedded in the internal electricity market framework; in several Central Asian and African members, it is infrastructure and financing constraints; in some Balkan and Caucasus members, it is the absence of a regulatory mandate. These are structurally different

obstacles requiring different policy responses, but the shared consequence is the same: without granular, real-time metering data, the demand-side flexibility that renewable integration increasingly requires cannot be activated.

The strategic implication for ERRA as a peer-learning forum is significant: members who have completed rollout have accumulated operational experience that is directly transferable to members still in the early stages, including deployment logistics, consumer communication, cybersecurity, billing accuracy, and third-party data access. The gap between Group 4 and Group 1–2 is not primarily a technology gap; it is a regulatory design and implementation gap that peer exchange can meaningfully narrow.

Area M — Electro-mobility: Rapid but Uneven Growth, with Regulatory Architecture Still Forming

Electro-mobility is the most dynamic of the three areas in this chapter, and also the one where regulatory frameworks are most in flux: the data capture a moment of rapid market development that regulatory systems are still catching up to define, contain, and enable.

Ten members at the highest tier (Group 4) represent a geographically and economically diverse coalition united by one characteristic: active, if varied, regulatory engagement with both sides of the EV equation, fleet growth and charging infrastructure. The presence of Georgia, Thailand, and Uzbekistan at Group 4 alongside France, Lithuania, and Austria demonstrates that advanced electro-mobility development is not the preserve of high-income EU economies. What the Group 4 members share is less a specific regulatory model than a combination of clear grid connection rules, competitive charging markets, and policy signals that have supported infrastructure investment.

The Group 3 cluster — Poland, Hungary, Azerbaijan, Kazakhstan, Romania — surfaces the most immediate regulatory challenge: EV registration is growing faster than charging infrastructure, creating an imbalance that risks becoming self-reinforcing. Insufficient charging points suppress adoption among non-early-adopters; slow adoption reduces the commercial case for charging investment. Regulators in these systems face a classic coordination problem: the optimal outcome requires simultaneous action on both sides of the market, which neither the grid operator nor the charging market can deliver independently.

The clearest structural finding across all three groups is the absence of a settled regulatory model for the DSO's role in charging infrastructure. Three distinct approaches are visible in the ERRA membership: DSOs prohibited from owning charging assets (Lithuania), DSOs responsible for connection but not commercial operation (Georgia, Romania), and systems where the DSO boundary is still undefined. This regulatory question — more than any technology or financing question — will determine whether charging infrastructure expands at the pace that EV adoption requires.

CH.5 | IMPLICATIONS FOR ERRA MEMBERS

For Members Seeking to Advance Renewable Integration (Area K)

For members in Groups 1–2: The operational priority is developing the adequate regulatory framework that will be needed before renewable penetration rises to Group 3 levels. This means establishing functioning balancing arrangements, clarifying the regulatory framework for grid-scale storage, and resolving the grid connection regime (deep vs. shallow, first-come-first-served vs. first-ready-first-served) before a connection queue backlog develops. The evidence from Group 3 members suggests that the regulatory costs of managing integration challenges reactively – after the flexibility gap has appeared – are substantially higher than addressing them proactively.

For members in Group 3: The central regulatory question is no longer whether to accommodate variable renewable generation but how to design market mechanisms and network investment frameworks that make accommodation efficient and cost-effective. Specific priorities include: formalising the procurement framework for flexibility services (balancing, reserves, demand response); developing an adequacy assessment methodology that accounts for the reduced contribution of intermittent capacity; and reviewing network tariff structures for renewable generators to ensure that connection charges do not create perverse incentives for suboptimal siting. The smart metering and electro-mobility trajectories of Group 3 members are directly relevant: demand-side flexibility – unlocked by smart meters and potentially amplified by vehicle-to-grid – is the most cost-effective near-term flexibility resource available to most Group 3 systems.

For Members Seeking to Accelerate Smart Metering Deployment (Area L)

For members in Groups 0–1: Where metering gaps exist – as in parts of Nigeria and some African members – addressing universal metering coverage is the first priority, and requires a different toolkit from smart meter deployment: it is a network coverage and commercial governance challenge, not a technology replacement challenge. **Where universal metering is in place but smart meters have not been mandated, the priority is establishing a regulatory framework that defines functional specifications, rollout obligations, and data governance rules before procurement begins.** Starting with a functional specification rather than a technology specification allows the market to provide cost-competitive solutions and avoids lock-in to rapidly evolving metering architectures.

For members in Groups 2–3: The operational focus shifts from mandate design to rollout execution and data activation. The experience of countries like France, Austria, and Estonia demonstrates that mass rollout is manageable at scale if supported by clear regulatory milestones, transparent consumer communication, and a defined data access framework for third parties. **The most common source of rollout delay in EU members has been the cost-benefit analysis requirement:** members that structured their CBA around system-level benefits – grid planning, loss reduction, balancing – rather than purely consumer-level benefits resolved the CBA gate more quickly and proceeded to rollout at scale.

For Members Seeking to Support Electro-mobility Development Harmonized with Network Development (Area M)

For members in Groups 0–1: The regulatory priority is establishing the basic grid connection framework for EV charging stations — including a clear definition of whether charging is a regulated or competitive activity, as well as a standardised connection process at DSO level, and basic metering requirements for private charging. These foundational elements do not require a full electro-mobility regulatory framework: they can be addressed through targeted amendments to existing distribution network codes and supply regulations. Delaying this work until EV adoption is already significant creates the queue management and standards confusion that several Group 3 members are now managing.

For members in Groups 2–3: The key regulatory task is resolving the DSO boundary question before the charging network reaches the scale at which the DSO-market interface becomes commercially significant. The options — prohibition of DSO ownership, mandated separation of connection from commercial operation, or regulated DSO participation as operator of last resort — each have different implications for deployment pace, competitive market development, and grid integration quality. The choice should be made deliberately, not by default. Members in Group 3 with a demonstrable infrastructure gap should additionally consider whether targeted regulatory incentives for charging point deployment — such as Georgia’s 50% reduction in connection fees for publicly accessible stations — could help rebalance the gap between EV fleet growth and charging infrastructure.

For members in Group 4: The emerging frontier is vehicle-to-grid (V2G) regulation: the rules governing bidirectional charging, the tariff treatment of energy injected from EVs, and the integration of EV charging loads into flexibility and balancing markets. The regulatory framework for V2G deployment needs to be anticipated in network codes and market rules before the technology arrives at commercial scale, not after — a lesson that applies equally to the connection frameworks and data standards that will govern smart charging at high EV penetration levels.

ANNEXES

A1 | LIST OF COUNTRY-BASED CASES (“BOXES”)

Ch.	Area	Topic	Regions					
			EU	Europe non-EU	Middle East & Gulf	Caucasus & Central Asia	Africa	Rest of the World
Ch. 1	A	Regulatory Independence	SK (box n.1)		OM (box n.2)		CM and East Afr.* (box n.3-4)	
	B	Multisectoral Jurisdiction		TR (box n.5)	SA (box n.5)			
Ch. 2	C	Customer Protection		AL (box n.7)			DZ (box n. 6)	PK (box n. 8)
	D	Households Electricity Price Regimes	GR (box n.9)					
	E	Electricity Retail Market	FR (box n.10)					
Ch. 3	F	TSO & DSO Unbundling		TR (box n.11)				
	G	Electricity Wholesale Market Develop				KZ (box n.13)		TH (box n.12)
	H	Regional Electricity Wholesale Market	LV-LT-EE (box n.15)				NG (box n.14)	
Ch. 4	I	Regulatory Incentives to Grid Operators	FR-AT (box n.17 and n.18)	MD (box n.16)				
	J	Electricity Network Tariff Structure	GR (box n.19)					MN (box n.20)
Ch. 5	K	Renewables Development	LV (box n.23)	MD-UA (box n.21 and n.22)				
	L	Smart Metering (Electricity)	LT (box n.25)			UZ (box n.24)		US ** (box n.26)
	M	Electro-mobility Developments				GE (box n.27)		US ** (box n.28)

Acknowledgements: (*) EREA; (**) NARUC

A2 | RESEARCH PROCESS

This ERRA Mapping Report is based on a methodology designed to collect comparable qualitative and quantitative information from all ERRA member regulators across 15 regulatory areas. The process was developed and led by the ERRA Research Unit between July 2025 and early March 2026.

Each participating regulator received a standardised interview outline, structured around 15 regulatory areas, covering topics from regulatory independence and consumer protection to wholesale market development, network regulation, renewables, and innovation. For each area, a grouping system was applied to allow cross-country comparison while preserving qualitative nuance. For Area 1 (Regulatory Independence), an additional qualitative questionnaire – drawing on the Gilardi Index methodology – was included (see Annex A4). Regulators were asked, as far as possible, to pre-fill the outline and return it in advance of the interview to maximise the quality of the discussion.

Fact-finding structured interviews were conducted via Zoom calls between the ERRA Research Unit and the management of each member organization. Calls were conducted in English, with Russian available as an alternative, and were recorded for the purposes of note-taking. Each interview lasted approximately two hours. The choice of participating staff was left to each organization; in general, two or three senior staff with experience in international regulatory affairs participated.

The research process was structured in two phases. A pilot phase was conducted between July and October 2025 with eleven selected member regulators, culminating in a discussion of results at the ERRA Presidium meeting in Ankara (October 2025). A full survey phase followed from October 2025 through March 2026, covering all remaining members. Of the 39 ERRA member organisations invited, 38 participated; AES Serbia decided not to participate in the Mapping exercise.²⁴

In parallel, a quantitative data collection was orchestrated with all involved countries, using also EMBER data as for renewables generation and installed capacity.

Two regulatory associations that are associated ERRA members cooperated in this project: NARUC (National Association of Regulatory Utility Commissions) has contributed for case studies of smart metering and e-mobility in United States. EREA (East Africa Regulatory Energy Association) cooperated with ERRA for the analysis of Gilardi index of their members.

The first findings were reviewed with the ERRA Presidium in January and March 2026, and the report was submitted in April 2026 for comments to ERRA members.

The report is to be presented at the ERRA Annual Conference and at the ERRA General Assembly in Bratislava, April 2026.

²⁴ One regulator has been involved per each country; in those countries (like Bosnia and Herzegovina, Azerbaijan) where there are more than one ERRA members, the full ERRA member has been involved.

A3 | LIST OF INVOLVED REGULATORS

Region	Code	Country	Regulator	Date of interview
EU	AT	Austria	Energie-Control Austria (E-Control)	11 Sept. 25
	BG	Bulgaria	Energy and Water Regulatory Commission (EWRC)	14 Jan. 26
	HR	Croatia	Croatian Energy Regulatory Agency (HERA)	26 Nov. 25
	CZ	Czech Republic	Energy Regulatory Office (ERO)	24 Oct. 25
	EE	Estonia	Estonian Competition Authority (ECA)	12 Dec. 25
	FR	France	Energy Regulatory Commission (CRE)	20 Nov. 25
	GR	Greece	Regulatory Authority for Energy, Waste and Water (RAAEY)	23 Oct. 25
	HU	Hungary	Hungarian Energy and Public Utility Regulatory Authority (MEKH)	03 July 25
	LV	Latvia	Public Utilities Commission (PUC)	30 Sept. 25
	LT	Lithuania	National Energy Regulatory Council (NERC)	25 Nov. 25
	PL	Poland	Energy Regulatory Office (URE)	10 July 25
	RO	Romania	Romanian Energy Regulatory Authority (ANRE)	15 Jan. 26
	SK	Slovakia	Regulatory Office for Network Industries (ÚRSO)	22 Jan. 26
Europe non-EU	AL	Albania	Albanian Energy Regulatory Authority (ERE)	10 Sept. 25
	BA	Bosnia and Herzegovina	State Electricity Regulatory Commission (SERC)	11 Nov. 25
	XK	Kosovo*	Energy Regulatory Office (ERO)	15 Jan. 26
	MD	Moldova	National Agency for Energy Regulation (ANRE)	03 Oct. 25
	MK	North Macedonia	Energy, Water Services and Municipal Waste Management Services Regulatory Commission (ERC)	20 Nov. 25
	TR	Türkiye	Energy Market Regulatory Authority (EMRA)	12 Nov. 25
	UA	Ukraine	National Energy and Utilities Regulatory Commission (NEURC)	20 Jan. 26

Region	Code	Country	Regulator	Date of interview
Middle East and Gulf	OM	Oman	Authority for Public Services Regulation (APSR)	28 Jan. 26
	SA	Saudi Arabia	Saudi Electricity Regulatory Authority (SERA)	04 Feb. 26
	AE	UAE (Dubai)	Regulation and Supervision Bureau for Electricity and Water of Dubai (RSB)	06 Jan. 26
Caucasus	AM	Armenia	Public Services Regulatory Commission (PSRC)	07 July 25
	AZ	Azerbaijan	Tariff (Price) Council (TC)	02 Oct. 25
	GE	Georgia	Georgian National Energy and Water Supply Regulatory Commission (GNERC)	07 Oct. 25
Central Asia	KZ	Kazakhstan	Committee on Regulation of Natural Monopolies of the Ministry of National Economy	28 Nov. 25
	KG	Kyrgyzstan	Department for Fuel and Energy Complex Regulation under the Ministry of Energy	24 Oct. 25
	UZ	Uzbekistan	Energy Market Development and Regulatory Agency (EMDRA)	04 Dec. 25
Africa	DZ	Algeria	Electricity and Gas Regulatory Commission (CREG)	31 July 25
	CM	Cameroon	Electricity Sector Regulatory Agency (ARSEL)	24 Sept. 25
	EG	Egypt	Gas Regulatory Authority (GasReg)	12 Feb. 26
	MZ	Mozambique	Energy Regulatory Authority (ARENE)	09 Dec. 25
	NG	Nigeria	Nigerian Electricity Regulatory Commission (NERC)	23 July 25
Rest of the World	BS	Bahamas	Utilities Regulation and Competition Authority (URCA)	04 Dec. 25
	MN	Mongolia	Energy Regulatory Commission (ERC)	08 Dec. 25
	TH	Thailand	Energy Regulatory Commission (ERC)	24 Nov. 25
	PK	Pakistan	National Electric Power Regulatory Authority (NEPRA)	19 Nov. 25

A4 | QUESTIONNAIRE FOR GILARDI INDEX

QUESTIONS ABOUT THE MEMBERS OF THE BOARD

1. Term of office

- over 8 years
- 6-8 years
- 5 years
- 4 years
- fixed term under 4 years
- at discretion of the appointer
- no fixed term

Authority Chairperson	Other Board members

2a. Who appoints the Chairperson?

- the members of the Authority board
- a complex mix of the parliament and the government
- the parliament
- the government collectively
- one or two ministers

2b. Who appoints the other Board members?

- the Chairperson
- a complex mix of the parliament and the government
- the parliament
- the government collectively
- one or two ministers

3. Dismissal

- dismissal is impossible
- dismissal is possible, but only for reasons not related to policy
- there are no specific provisions for dismissal
- dismissal is possible at the appointer's discretion

4. May any Board member hold other offices?

- No
- only with the permission of the government
- yes/ no specific provisions

5. Is the appointment renewable?

No
 yes, once
 yes, more than once

QUESTIONS ABOUT THE ORGANISATION

6. Is the independence of the Authority formally stated?

Yes
 No

7. What are the formal obligations of the Authority vis-à-vis the government?

there are no formal obligations
 presentation of an annual report for information only
 presentation of an annual report that must be approved
 the Authority is fully accountable to the government

8. What are the formal obligations of the Authority vis-à-vis the parliament?

there are no formal obligations
 presentation of an annual report for information only
 presentation of an annual report that must be approved
 the Authority is fully accountable to the parliament

9. Which body, other than a court, can overturn the decisions of the Authority where the latter has exclusive competence?

no body
 a specialised body
 the government, with qualifications
 the government, unconditionally

10. Financial and organizational autonomy

What is the source of the Authority's budget?
 fees levied on the regulated industry
 both the government and fees levied on the regulated industry
 the government

11. How is the budget controlled?

by the Authority

by the accounting office or court

by both the Authority and the government

by the government only

12. Which body decides on the Authority's internal organisation?

the Authority itself

both the Authority and the government

the government

13. Which body is in charge of the Authority's personnel policy (hiring and firing staff, deciding on its allocation and composition)?

the Authority

both the Authority and the government

the government

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