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INSTITUTIONAL CAPACITY OF PUBLIC ADMINISTRATION FOR THE DEVELOPMENT OF ELECTRIC-VEHICLE CHARGING INFRASTRUCTURE

Abstract. The article develops an approach to assessing the institutional capacity of public administration for electric-vehicle charging infrastructure as part of the energy modernisation of road mobility. The analysis proceeds from the premise that the number of charging points alone does not describe policy quality. Territorial accessibility, charging capacity, technical interoperability, digital connectivity, transparent user conditions, interaction with electricity grids and the ability of public authorities to coordinate these components are equally relevant. A five-component capacity model is proposed, covering strategic and regulatory governance, spatial infrastructure, electricity-grid readiness, digital information, and service and workforce capacity. The paper outlines maturity levels from fragmented regulation to adaptive governance, defines a bottleneck logic for integrated assessment, and examines the role of independent vehicle service providers in the transformation of the automotive ecosystem. The proposed approach links infrastructure deployment with grid readiness, data availability, service capacity and measurable public outcomes.

Keywords: public administration; electric mobility; charging infrastructure; road transport; institutional capacity; energy transition; vehicle service.

Problem statement

The electrification of road transport is gradually moving the issue of charging infrastructure from a narrow technical domain into the sphere of public administration.

In Ukraine, Law No. 2956-IX establishes state regulation of the use of vehicles equipped with electric motors and explicitly covers the creation and use of the relevant infrastructure [1]. In the European Union, Regulation (EU) 2023/1804 introduces a target-based regime for the deployment of alternative-fuels infrastructure, combining national objectives, technical specifications, data requirements and user accessibility [2]. For Ukraine, this creates a dual context: the domestic electric-vehicle market is developing while transport and energy policy are simultaneously converging with the European model.

The policy problem is not simply the absence of individual charging points. A charging network operates at the intersection of road transport, electricity supply, spatial planning, land use, digital services, consumer protection and vehicle maintenance. Installing a station where sufficient grid capacity is unavailable does not solve a mobility problem. Expanding the number of electric vehicles without reliable service capacity increases operational risks. Likewise, the formal presence of a charging point does not mean that it is practically accessible when information on status, price or connector compatibility is incomplete. The object of governance is therefore not an isolated infrastructure element but a system of interdependencies.

International market dynamics reinforce the relevance of this approach. According to the International Energy Agency, global electric-car sales exceeded 20 million vehicles in 2025 and electric cars reached roughly one quarter of new-car sales worldwide [5]. Charging capacity is expanding in parallel and fast and ultra-fast solutions are becoming more common [6]. The acceleration of the technological transition changes the administrative task: policy should not merely catch up with already-formed demand but should identify infrastructure, grid and service constraints in advance.

Analysis of recent research and publications

The regulatory foundation for the analysis is provided by Ukraine's Law No. 2956-IX and Regulation (EU) 2023/1804 [1; 2]. Ukrainian legislation establishes the

conceptual framework for electric transport and charging infrastructure and defines the sphere of state regulation. The European act broadens the governance framework by setting deployment objectives and requirements for publicly accessible charging points, digital connectivity, smart charging, user information and market monitoring [2]. Technical rules for vehicle-to-grid communication and related technologies are further developed in Commission Delegated Regulation (EU) 2025/656 [3], while rules for the availability and accessibility of static and dynamic alternative-fuels infrastructure data are established by Commission Implementing Regulation (EU) 2025/655 [4].

IEA analytical materials demonstrate that scaling electric mobility does not eliminate the need for infrastructure policy; it changes its structure. Home charging remains the main charging mode for users who have access to it, while public infrastructure is particularly important for long-distance travel and for drivers without a private charging location [6]. The methodological implication is that the number of public charging points cannot serve as a universal indicator of adequacy. Assessment must take account of settlement type, trip patterns, charging power, territorial coverage and the structure of private charging.

Existing regulatory and analytical approaches describe separate technical and market components in considerable detail. Less developed is their integration into a model of institutional capacity for public administration, where the object of evaluation is not a technology itself but the ability of public authorities to coordinate transport, energy, spatial, digital and service decisions. This gap defines the direction of the present study.

Purpose of the article

The purpose of the article is to substantiate a methodological approach to assessing the institutional capacity of public administration for the development of electric-vehicle charging infrastructure, to identify its structural components and maturity levels, and to formulate a governance mechanism that synchronises the charging network, the electricity system, digital information and service capacity.

Presentation of the main material of the study

Institutional capacity as a governance construct

Institutional capacity in the field under study is interpreted as the ability of the public-administration system to establish predictable rules, coordinate actors, ensure spatial and energy-system consistency of infrastructure, maintain a reliable information environment and adjust policy on the basis of measurable results. This definition distinguishes institutional capacity from market scale. A market may grow quickly under favourable prices and consumer demand, yet such growth does not ensure that infrastructure appears where it is needed, that grid connections occur without systemic delay or that the user receives a transparent and reliable service.

The first component is strategic and regulatory. It covers the consistency of transport and energy objectives, allocation of competences, stability of rules and the state's capacity to define the sequence of transition. Regulation (EU) 2023/1804 is instructive as a governance construction because it combines binding targets, national policy frameworks, technical requirements and reporting mechanisms [2]. For Ukraine, the important lesson is not the mechanical reproduction of European quantitative parameters but the logic of measurable infrastructure objectives and a regular review cycle.

The second component is spatial infrastructure. The charging network should correspond to the real geography of demand. In dense urban areas, the decisive constraint may be the absence of private overnight parking. On interurban routes, the problem may be insufficient high-power charging. In smaller communities, low commercial attractiveness can constrain investment. Different territories therefore require different policy instruments. A universal indicator such as the number of stations obscures the difference between a low-power point in an oversupplied area and a high-power hub on a route where no alternative exists.

The third component concerns electricity-grid readiness. An electric vehicle is a new electricity consumer, but for the grid the critical issue is not only the amount of

energy consumed; timing and concentration of demand also matter. The IEA notes that smart charging can shift load away from peak periods and that vehicle-to-grid solutions may create additional system flexibility, although the regulatory and standards environment for V2G continues to develop [5]. A public-administration model must therefore consider not only the construction of charging points but also the modes of their interaction with the power system.

Table 1.1. Components of institutional capacity for public administration of charging infrastructure

Component	What is assessed	Indicator of established capacity
Strategic and regulatory	objectives, competences, stability of rules, coordination	infrastructure decisions are linked to measurable objectives
Spatial infrastructure	coverage, charging power, location types, accessibility	the network corresponds to the geography and patterns of demand
Electricity-grid readiness	connection procedures, local capacity, smart charging	charging load is integrated without systemic bottlenecks
Digital information	static and dynamic data, status, price, compatibility	users and public authorities have up-to-date machine-readable information
Service and workforce	diagnostics, high-voltage work, training, safety	technological renewal is supported by accessible qualified service

Source: developed by the author.

Digital information and service capacity

The digital-information component has independent significance because charging infrastructure is simultaneously physical and digital. Users need reliable data on location, availability, charging power, connector type, price and actual operating status. Public authorities need the same data to assess territorial coverage, utilisation and shortages. Commission Implementing Regulation (EU) 2025/655 treats static and dynamic infrastructure data as an integral part of the infrastructure standard [4]. This

marks a transition from a model in which data are a by-product of operator activity to one in which data availability is itself a public-policy requirement.

The fifth component, service and workforce capacity, is often absent from infrastructure debates even though the vehicle fleet cannot function without maintenance. Electrification changes the structure of service operations: some traditional activities decline in importance, while high-voltage safety, power-electronics diagnostics, traction-battery condition, thermal management and software systems become more significant. Independent workshops therefore need new equipment and training. For public administration, this means treating the service sector as part of institutional readiness for the transition rather than merely as private after-sales activity.

The relationship between the components is nonlinear. Strength in one dimension cannot fully compensate for a critical weakness in another. A high density of charging points does not solve the problem if many points are unavailable or fail to provide current data. Sufficient national electricity generation does not remove local distribution-grid constraints. A rapidly expanding electric-vehicle fleet is not sustainable without qualified repair and maintenance. An integrated assessment should therefore preserve the component profile and include a limiting rule based on the weakest link.

Maturity levels and the bottleneck rule

For practical assessment, each component can be decomposed into indicators and evaluated across four maturity levels: 0 – fragmented, where the relevant practice is absent or isolated; 1 – formalised, where rules exist but are applied inconsistently; 2 – integrated, where procedures are coordinated among the principal actors; and 3 – adaptive, where the system uses data, measures results and adjusts instruments. The scale does not replace sector-specific technical standards. Its purpose is to compare governance maturity.

Table 1.2. Levels of institutional capacity for charging-infrastructure governance

Level	Characteristics	Governance logic
0. Fragmented	isolated decisions without a coordinated framework	response to local shortages
1. Formalised	rules and responsible actors are partially defined	regulation of separate elements
2. Integrated	transport, energy and spatial decisions are coordinated	planning on the basis of shared data
3. Adaptive	monitoring, forecasting, smart charging and regular review are used	policy correction on the basis of results

Source: developed by the author.

Moving between maturity levels should not be equated with increasing public expenditure. Many institutional improvements are organisational: common data requirements, clear responsibility, alignment of grid-development plans with transport scenarios, and procedures for regular review. Budget intervention is justified where a clearly identified market or infrastructure gap exists, for example when a strategically important location lacks sufficient demand for private investment to be commercially viable. In other cases, the central public task is to establish predictable rules and non-discriminatory access.

The balance between home, workplace and public charging also matters. The IEA identifies home charging as the dominant mode for a large share of electric-vehicle owners, whereas public fast charging is disproportionately important for long-distance travel and for users without private parking [6]. Policy should therefore avoid measuring adequacy through a single infrastructure form. Multi-apartment buildings require workable connection rules; employment areas may support daytime charging; and major corridors require reliable high-power hubs. Spatial planning should begin with the function of the charging point, not merely its count.

Technical interoperability is another area in which public regulation creates the conditions for a functioning market rather than replacing the market. Regulation (EU)

2023/1804 establishes common technical specifications, while the 2025 delegated rules extend standardisation to vehicle-to-grid communication and related technologies [2; 3]. For users, this reduces technological incompatibility. For operators, it increases investment predictability. For the state, it helps prevent infrastructure from fragmenting into closed technological systems.

A similar logic applies to service competence and safe procedures. The public interest is not to determine the commercial model of vehicle workshops but to ensure that the technology transition does not generate a shortage of safe, affordable repair. Short modular training programmes, updated occupational-safety requirements and clear qualification benchmarks can lower entry barriers for independent service providers. This is especially important outside major cities, where concentration of specialised repair capacity may itself become a barrier to electric-mobility uptake.

Adaptive governance and policy feedback

The governance mechanism begins with a strategic objective but does not end when a charging facility enters operation. Spatial planning translates a general objective into a map of needs. The grid-readiness layer tests technical feasibility. The operator makes an investment decision. Digital data reveal whether infrastructure is actually available and used. The service layer shows whether the new mobility model can be maintained after vehicle purchase. Evaluation returns this information to the strategic level. Without such feedback, policy can accumulate infrastructure without learning from results.

For Ukraine, adaptability also has a resilience dimension. Energy infrastructure operates in an environment of elevated risks, so simply increasing nominal charging capacity without considering redundancy and recoverability is insufficient. A distributed charging network, load-management capability, local energy-storage solutions and clear restoration priorities can be treated within a unified resilience framework. Specific technological choices should nevertheless be based on technical

and economic assessment rather than on declarative preference for a particular technology.

Performance should be evaluated at three levels. The first is accessibility: whether the user can actually obtain the service in the required place and time. The second is system efficiency: whether infrastructure placement corresponds to grid capacity and real demand. The third is the public outcome: whether policy contributes to lower fuel dependence, more resilient mobility and broader access to new technologies. Mixing these levels creates false conclusions in which commissioning an additional station is automatically counted as achievement of a strategic objective.

The proposed model does not require a single centralised operator or administrative determination of every investment. Its purpose is coordination. The state establishes standards, open information rules and access requirements; local governments integrate charging infrastructure into spatial planning; network operators provide technical connection conditions; private business invests and competes for users; and service enterprises maintain the vehicle fleet. Institutional capacity exists when these roles do not duplicate one another and do not leave critical gaps.

Practical application should begin with an inventory for each territory or transport corridor: the electric-vehicle fleet, existing charging points and their power, location types, grid constraints, service availability and data completeness. The result is not an abstract deficit of “chargers” but a concrete governance gap. The policy instrument follows from the type of gap: a change in connection rules, spatial reservation, a data standard, co-financing for an unprofitable strategic location, or a workforce-training programme. This approach reduces the risk of technology-led policy in which procurement or construction precedes problem definition. Charging infrastructure is a means of enabling mobility, not an end in itself.

A methodological limitation of the model is that some indicators require empirical calibration. An acceptable level of public charging capacity depends on the

share of home charging, travel patterns and the composition of the vehicle fleet; an optimal grid-connection time depends on the technical complexity of a specific site.

Table 1.3. Roadmap for strengthening institutional capacity

Stage	Main action	Result
1. Inventory	map demand, charging infrastructure, grid and service constraints	baseline capacity profile
2. Standardisation	align technical, information and procedural requirements	predictable rules for operators and users
3. Integration	link transport, energy and spatial planning	coordinated investment framework
4. Monitoring	use dynamic data on availability, load and service indicators	identification of bottlenecks
5. Adaptation	review instruments on the basis of monitoring results	policy that learns from actual data

Source: developed by the author.

The model should therefore be used as a comparative and diagnostic framework rather than as a set of universal technical norms. The next stage of research should test it across different territories and types of charging and vehicle-service infrastructure. The framework also connects professional vehicle-service practice with the field of public administration by treating service capacity as one element of the institutional ability of the state and market to sustain a new model of road mobility.

Conclusions

The development of electric-vehicle charging infrastructure should be treated as an intersectoral public-administration task rather than as a mechanical increase in the number of charging points. Ukrainian regulation already covers the creation and use of electric-transport infrastructure, while the European model demonstrates a further transition towards target indicators, technical interoperability, digital data and monitoring.

The article proposes a five-component model of institutional capacity comprising strategic-regulatory, spatial-infrastructure, electricity-grid, digital-information and service-workforce components. These components should be assessed as an interdependent system because a critical weakness in one component can constrain the effectiveness of the others.

Four maturity levels are distinguished: fragmented, formalised, integrated and adaptive. Progress to a higher level depends not only on investment but also on the quality of coordination, data, standards, planning and feedback. Service and workforce readiness should be included in the public-governance model of the transport-energy transition, since a shortage of safe and accessible maintenance can become as restrictive as an insufficient charging network.

Further research should focus on empirical calibration of quantitative indicators for different territorial types, testing of the bottleneck rule, and scenario modelling for the coordinated development of charging, grid and vehicle-service infrastructure in Ukraine.

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