RESEARCH PAPER NO. 01

Beyond Electrification

The Emergence of Transport Energy Infrastructure

Modern Mobility Institute Research Team

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Working draft - for internal review

About Modern Mobility Institute

Modern Mobility Institute is the research and policy arm of Modern Mobility, established to examine structural shifts in European transport and energy infrastructure. The Institute's analysis is grounded in public data from EU institutions, regulators and industry sources, and is prepared to editorial standards independent of any single commercial outcome.

Where this report discusses Modern Mobility's own technology, those figures and claims are held to the same evidentiary standard applied to every other source in this report - see Chapter 6 (Modern Mobility as Reference Architecture) and Section 6.4 specifically, which sets out what remains to be independently verified.

BEYOND ELECTRIFICATION – AT A GLANCE

1. Europe has won generation. It is losing delivery.

In 2025 wind and solar generated more EU electricity than fossil fuels for the first time. At the same time, €8.9 billion of clean power was curtailed in 2024 – generated but not delivered. The constraint has shifted from Energy Generation to Energy Availability.

2. Three funding gaps are one gap.

- Transport networks: €515bn needed by 2030 (TEN-T)
- Electricity grids: €584bn needed by 2030, 28 GW cross-border shortfall by 2040, 1,700 GW of renewables awaiting connection
- Transport-energy delivery: up to €240bn for 3.4m charging points by 2030
  Read separately, routine shortfalls. Read together, a single missing layer.

3. Transport Energy Infrastructure (TEI) is that layer.

The physical and operational assets that make energy available at the point where mobility, industry and logistics require it – irrespective of source, grid operator or mode. TEI is not a by-product of transport or grid policy. It is a distinct infrastructure category.

4. Why it matters now.

EU policy is already moving this way: the European Grids Package (Dec 2025) targets system integration, AFIR mandates real-time data and V2G-readiness, FuelEU Maritime mandates shore power by 2030. The regulation treats charging points and depot connections as energy-system nodes, not roadside amenities.

What this paper does: It defines TEI, shows why current planning silos miss it, and sets out its economics and policy implications for ministries, TSOs, port authorities and infrastructure investors.

Important Notices

Views Expressed

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Forward-Looking Statements

This report references EU regulatory proposals - including the European Grids Package - that had not been adopted in final form at the time of writing. Statements regarding future regulatory timelines, requirements or outcomes reflect information available as of the date of publication and are subject to change as the underlying legislative process continues.

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Editorial Process

Before publication, this report underwent an independent editorial review, including language refinement, consistency checks and stylistic harmonisation. All analytical conclusions and interpretations remain the responsibility of the author.

About the Author

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He brings more than 25 years of experience at the intersection of mobility, engineering and commercial execution - building and leading international organisations in fleet management, telematics and connected vehicle infrastructure across Europe, the Middle East and North America, with clients ranging from major public transport operators to global logistics companies. He was among the first practitioners on the continent to work with integrated EV-fleet data systems, at a time when electric mobility was still considered a niche proposition.

Since 2015, he has focused exclusively on building his own ventures at the frontier of transport electrification and energy infrastructure - from fleet electrification and EV market entry to the development of integrated transport-energy systems combining kinetic energy recovery, stationary storage, smart mobility and AI-based optimisation. His consistent focus across both phases of his career has been the same: turning technically sound ideas into infrastructure that works at scale, generates measurable value, and does not require a presentation deck to justify its existence.

Modern Mobility Institute was established as the research and policy expression of that work.

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Beyond Electrification: The Emergence of Transport Energy Infrastructure

Chapter 1 - Executive Summary

Europe is winning the easier half of its energy transition. In 2025, the European Union added a record amount of new renewable generation capacity, and wind and solar together generated more electricity across the EU than fossil fuels for the first time over a full calendar year. On current trajectories, the European Commission and the International Energy Agency expect the renewable share of EU electricity generation to rise from roughly 48 percent today to around 63 percent by 2030.

This report argues that this success has changed the nature of the strategic problem Europe now faces. The constraint on Europe's energy transition is shifting from **Energy Generation** - how much clean power can be produced - to **Energy Availability** - whether that power, and the infrastructure built to move it, reaches the specific points where transport, industry and logistics actually need it.

Three Layers, One Gap

Three infrastructure programmes that are normally analysed separately reveal the same underlying shortfall:

- Transport networks. The European Commission estimates that completing the core Trans-European Transport Network (TEN-T) will cost approximately €515 billion by 2030 and €850 billion by 2040. The European Court of Auditors concluded in January 2026 that the 2030 deadline will not be met.
- Electricity grids. The European Network of Transmission System Operators for Electricity (ENTSO-E)'s 2024 network development plan identifies a structural shortfall of 28 GW of cross-border transmission capacity by 2040. More than half of the transmission projects needed by 2030 are still awaiting permits, and over 1,700 GW of renewable capacity sits in grid connection queues across Europe.
- Transport-energy delivery. Industry analysis for the European Automobile Manufacturers' Association estimates that the EU-27 needs at least 3.4 million public charging points by 2030, at a cumulative cost of up to €240 billion - a build-out rate the current pace of installation does not yet match.

Read individually, each of these is a routine infrastructure funding gap. Read together, they describe a single pattern: capacity is being added, planned or funded in principle, while the connective layer that delivers energy to the point of transport, industrial or logistics demand consistently lags behind.

Why More Generation Has Not Closed the Gap

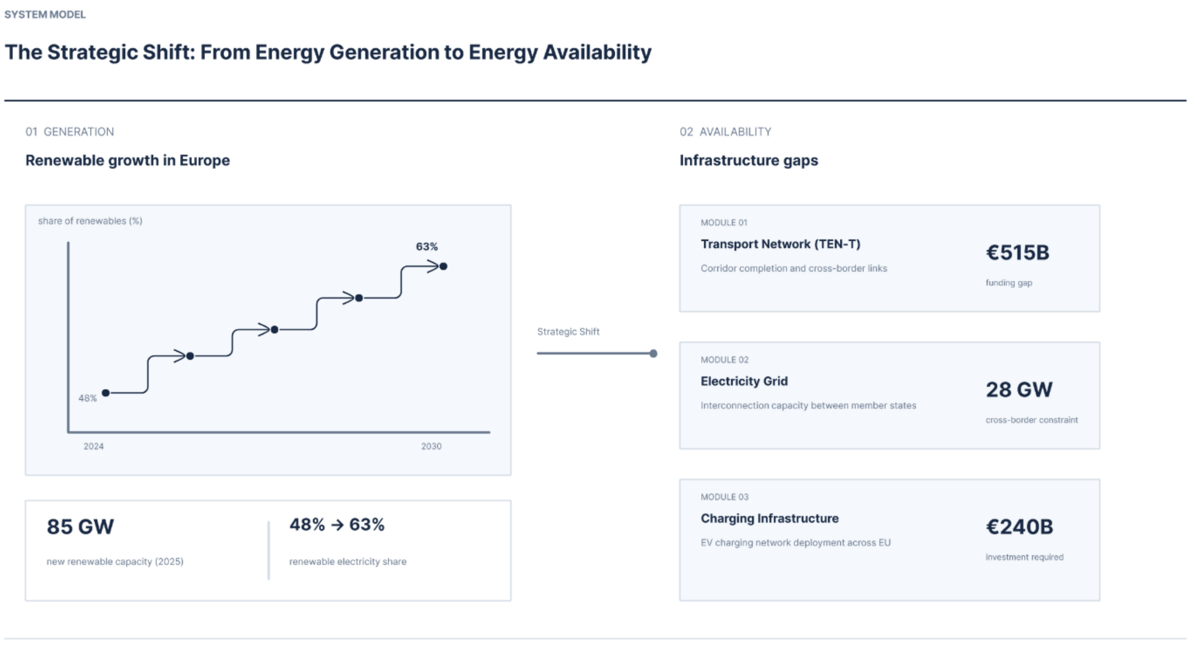
The data bears this out directly. Even as the EU added record renewable capacity in 2025, the cost of curtailing clean power that the grid could not absorb reached approximately **€8.9 billion** across Europe in 2024, with roughly 72 terawatt-hours curtailed - a volume comparable to Austria's annual electricity consumption. The European Commission's response, the European Grids Package presented in December 2025, reflects a policy shift toward **System Integration**: the recognition that grid delivery, not generation capacity, is now the binding constraint.

A New Infrastructure Category

This report proposes **Transport Energy Infrastructure (TEI)** as the term for this connective layer: the physical and operational assets that make energy available at the specific points where mobility, industry and logistics require it, regardless of which generation source, grid operator or transport mode is involved. Treating this layer as a distinct infrastructure category - rather than as a by-product of transport policy, grid policy or vehicle policy considered separately - is the central strategic argument of this report.

What Follows

The remaining chapters build out this argument in stages: defining the characteristics that distinguish TEI from conventional transport or energy assets, examining a reference architecture for how this infrastructure class can be deployed in practice, setting out its economics and deployment scenarios, and drawing out the policy and investment implications for the institutions, operators and capital providers this report is addressed to.



Constraint shifts from generation capacity to system-wide energy availability.

Who Should Read This

The analysis is directed at infrastructure ministries, the European Commission and European Investment Bank, transmission and distribution system operators, motorway and port operators, and the infrastructure investors, pension funds and infrastructure funds for whom Transport Energy Infrastructure represents an emerging and currently underdefined asset class.

Note on sources: *All figures cited in this Executive Summary are drawn from the analysis and sources set out in full in Chapter 2 (The Infrastructure Gap) and Chapter 3 (Beyond Generation). No new claims are introduced here beyond what those chapters establish.*

Sources:

As referenced in Chapters 2 and 3: European Commission (TEN-T), ENTSO-E TYNDP 2024, McKinsey/ACEA analysis, IEA Global Energy Review 2026, Ember European Electricity Review 2026, Eurostat

Chapter 2 - The Infrastructure Gap

2.1 Three Layers of One Shortfall

Europe is currently funding three infrastructure programmes that, on paper, address three separate problems: completing the long-distance transport network, expanding the electricity grid, and rolling out the charging and refuelling points that connect vehicles, fleets and logistics operations to that energy. Reviewed individually, each programme reports its own funding gap. Reviewed together, the data suggests they are facets of a single, larger shortfall.

On the transport network layer, the European Commission estimates that completing the core Trans-European Transport Network (TEN-T) by 2030 will require approximately **€515 billion**, rising to roughly **€850 billion by 2040**. Against this, the Connecting Europe Facility, the EU's dedicated transport funding instrument, currently provides around €25.8 billion in support - a small share of the total requirement. A January 2026 assessment by the European Court of Auditors concluded that the 2030 completion deadline for the core network will not be met, with the eight flagship projects under review running 82 percent over their original cost estimates. As the auditor who led the review put it: “Europe can not afford more decade-long delays for transport projects.”

On the electricity grid layer, ENTSO-E's 2024 Ten-Year Network Development Plan identifies a structural shortfall of **28 GW of cross-border transmission capacity by 2040**, relative to the projects already under development. Broader estimates covering transmission and distribution together - drawn from the European Commission's own modelling underlying the EU Grids Action Plan - put total investment needs at around **€584 billion by 2030**. More than half of the transmission projects required by 2030 are still awaiting permits, and an estimated 1,700 GW of renewable generation capacity across sixteen European countries is currently held in grid connection queues.

On the transport-energy delivery layer - the point at which electricity and alternative fuels actually reach a vehicle, a fleet, or a logistics depot - an analysis prepared by McKinsey for the European Automobile Manufacturers' Association projects that the EU-27 will need at least **3.4 million public charging points by 2030** (up to 7.6 million in a higher-demand scenario), at a cumulative build-out cost of up to **€240 billion**. The International Energy Agency's 2025 Global EV Outlook puts the required pace at roughly 210,000 new public charging points per year through 2030. For heavy-duty electric trucks specifically, the EU's Alternative Fuels Infrastructure Regulation (AFIR) is projected to cover only 50 to 70 percent of EU-27 public charging needs by 2030, falling to 35-45 percent coverage on the wider comprehensive TEN-T network.

> *“Europe can not afford more decade-long delays for transport projects.”*

- Annemie Turtelboom, Member of the European Court of Auditors, January 2026

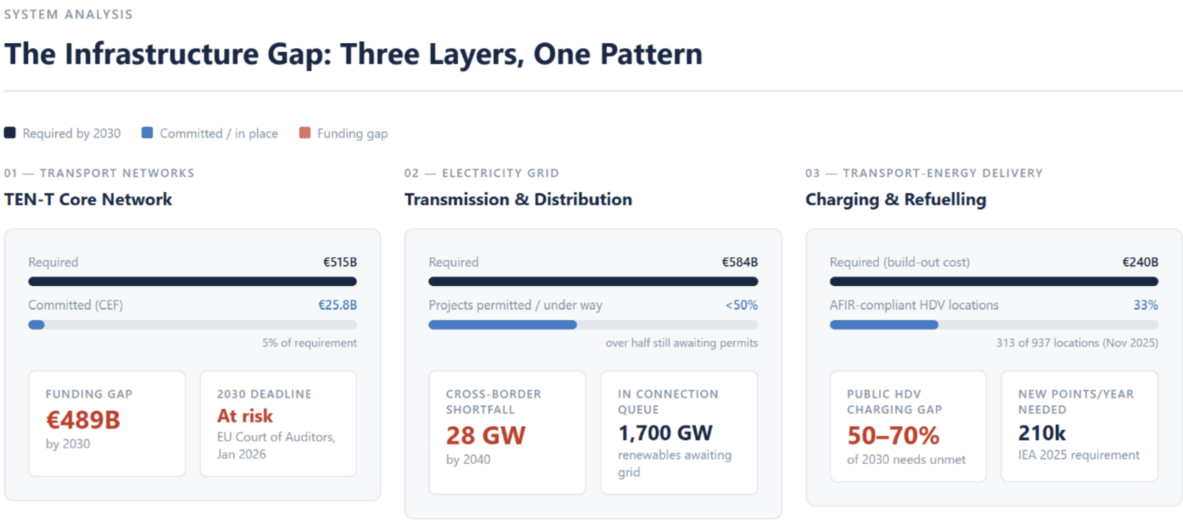


Exhibit 2.1 — Sources: European Commission TEN-T cost estimates; CEF transport allocation; ENTSO-E TYNDP 2024; EU Grids Action Plan; McKinsey/ACEA EV charging analysis; EAFO HDV Infrastructure Data (Nov 2025); IEA Global EV Outlook 2025. Figures drawn from sources with differing methodologies and time horizons — see Chapter 10.

2.2 A Common Pattern, Not Three Unrelated Problems

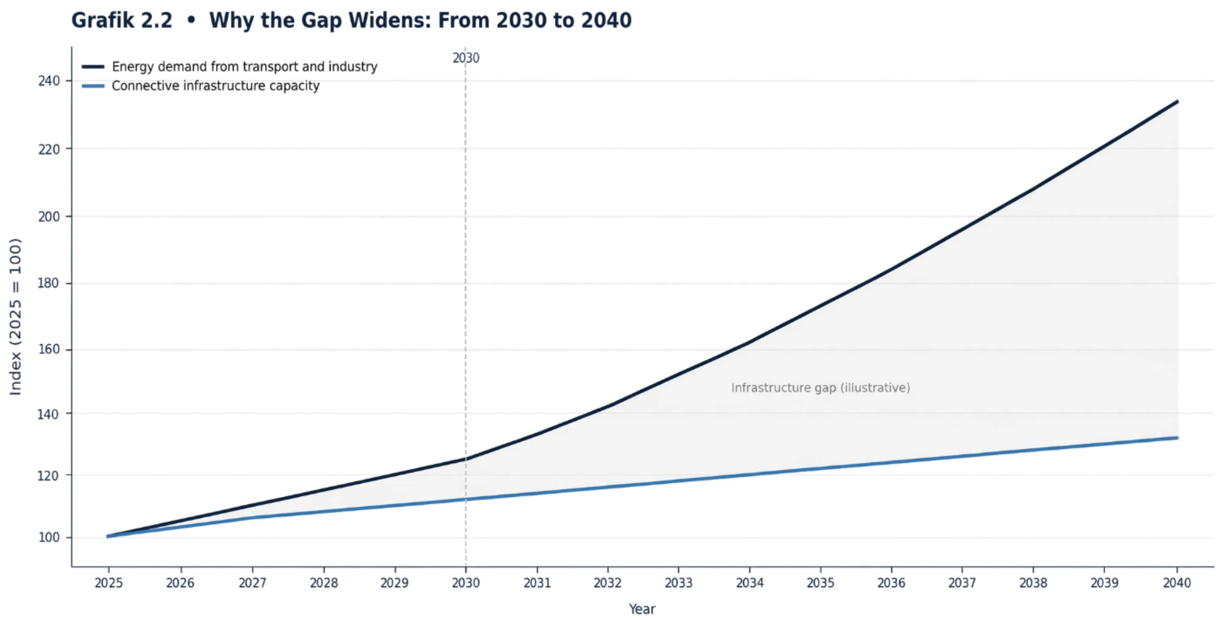
These figures originate from three different institutions, three different methodologies, and three different planning horizons. Read individually, each looks routine - large infrastructure programmes regularly report funding gaps. Read together, they describe the same underlying pattern: capacity is being added, planned, or funded in principle, while the connective layer that delivers energy from generation to point of use consistently lags behind.

This is the practical meaning of Energy Availability as distinct from Energy Generation. Europe is not short of installed renewable capacity, nor of long-term political commitment to decarbonised transport. It is short of the infrastructure that moves that energy to where transport, industry and logistics actually consume it - across borders, across the last mile of the grid, and at the point where a vehicle, vessel or fleet depot connects to the system.

2.3 Why the Gap Persists Across Three Silos

Part of the explanation is structural rather than purely financial. Transport network planning (TEN-T), grid planning (the ENTSO-E Ten-Year Network Development Plan), and transport-energy delivery planning (AFIR and national charging strategies) are governed by separate regulations, separate institutions, and separate investment cycles. Each is analysed, funded and audited on its own terms. None of the three frameworks is designed to evaluate the combined system - the point at which a transport corridor, a grid connection, and a charging or refuelling site must function as a single operational unit for energy to actually become available where it is needed.

This is consistent with the lengthy permitting timelines, the persistent grid connection queues, and the recurring gap between announced targets and delivered capacity that appear across all three programmes. The shortfall is not a forecasting error in any single plan. It is a category that none of the existing plans was built to capture.



Sources: ENTSO-E TYNDP 2024; European Commission TEN-T

2.4 Toward a Single Infrastructure Category

Closing this gap requires treating the connective layer between energy generation and transport energy demand as infrastructure in its own right - planned, financed and operated as a distinct category, rather than as a by-product of transport policy, grid policy or vehicle policy considered separately.

This report refers to this category as **Transport Energy Infrastructure (TEI)**: the layer of physical and operational assets that makes energy available at the specific points where mobility, industry and logistics require it, irrespective of which generation source, grid operator or transport mode is involved.

The remainder of this report develops the case for treating TEI as a distinct infrastructure class - first by examining why the underlying shift from generation to availability changes the nature of the problem (Chapter 3), then by setting out the characteristics that distinguish this class of infrastructure from conventional transport or energy assets (Chapter 5).

Note on sources: *The estimates cited in this chapter are drawn from European Commission modelling, ENTSO-E's Ten-Year Network Development Plan, and industry analyses prepared for the European Automobile Manufacturers' Association and the International Energy Agency. These sources differ in methodology, scope and time horizon, and are not directly comparable on a like-for-like basis. Chapter 10 (Limitations and Open Questions) returns to these methodological differences and to the open questions they raise for the analysis.*

Sources to Chapter 2

- *European Commission / Transport and Mobility DG - TEN-T core network cost estimates (€515bn by 2030 / €850bn by 2040), via Transport & Environment, "The State of the EU's Rail Infrastructure", June 2025.*
- *European Parliament, "Financing the Trans-European Networks", Fact Sheets on the European Union - CEF transport budget figures.*
- *European Court of Auditors, Special Report "EU transport infrastructure: Further delays and some cost increases, but a reinforced governance framework is in place for the future", January 19, 2026.*
- *ENTSO-E, Ten-Year Network Development Plan (TYNDP) 2024, Infrastructure Gaps Report.*

- *Ember, “Money on the line: scaling electricity interconnection for Europe's energy future”, April 2026 (analysis of TYNDP 2024 data).*
- *Bruegel, “Upgrading Europe's electricity grid is about more than just money” - EU Grids Action Plan investment estimate (€584bn by 2030).*
- *Clean Energy Wire, “Q&A: EU Grid Package” - permitting backlog and renewable connection-queue figures (1,700 GW / 16 countries).*
- *McKinsey & Company, analysis prepared for ACEA (European Automobile Manufacturers' Association), “Europe's EV opportunity - and the charging infrastructure needed to meet it”, 2022/2025 update.*
- *International Energy Agency, Global EV Outlook 2025 - electric vehicle charging section. International Council on Clean Transportation (ICCT), “Charging infrastructure needs for battery electric trucks in the European Union by 2030”, October*

Chapter 3 - Beyond Generation

3.1 The Generation Phase Has Outpaced Expectations

By most measures, the decarbonisation of European electricity generation is advancing faster than official targets anticipated. The European Union added approximately **85 GW of new renewable capacity in 2025** - a record high and roughly 10 percent more than in 2024, with solar photovoltaics accounting for the majority of the increase. For the first time, wind and solar combined generated more electricity across the EU than fossil fuels over a full calendar year - **30 percent of EU power versus 29 percent from fossil sources**. The International Energy Agency projects that the renewable share of EU electricity generation will rise from roughly 48 percent in 2025 to around 63 percent by 2030.

This is, by the standards of the sector, a rapid structural shift. It is consistent with the first half of the central thesis set out in this report: the initial phase of Europe's energy transition - building clean generation capacity - is working, and working at a pace that would have seemed ambitious a decade ago.

3.2 Yet More Generation Has Not Solved the Underlying Problem

The same year that produced this record generation growth also produced a less reported figure: renewables' overall share of EU electricity actually **edged down slightly, by 0.2 percentage points**, because weather variability reduced wind output by around 3 percent and hydropower by around 12 percent - and the resulting shortfall was met by burning more gas, not by drawing on the additional solar and wind capacity already installed. Adding generation capacity, in other words, does not by itself guarantee that the corresponding energy reaches the system when and where it is needed.

The clearest evidence of this is the rising cost of **curtailment** - clean power that is generated but cannot be transported to demand and is therefore switched off. Across Europe, the cost of curtailing renewable output and compensating generators reached approximately **€8.9 billion in 2024**, with roughly 72 terawatt-hours of mostly renewable electricity curtailed because of grid bottlenecks - a volume comparable to Austria's entire annual electricity consumption. In Spain, technical curtailment of renewable output, which had run at 1-3 percent through most of 2024 and early 2025, spiked to nearly 11 percent in July 2025 during a period of strong solar and wind output that the grid could not fully absorb. Separately, the EU's electricity regulator, the Agency for the Cooperation of Energy Regulators (ACER), has estimated that fragmented cross-border coordination cost the bloc close to **€11 billion in 2024** alone.

As set out in Chapter 2, more than half of the transmission projects required by 2030 are still awaiting permits, and well over a thousand gigawatts of renewable capacity across Europe currently sit in grid connection queues rather than feeding the system. The pattern across both chapters is the same: the constraint has moved from how much clean energy can be produced to how reliably it can reach the point of demand.

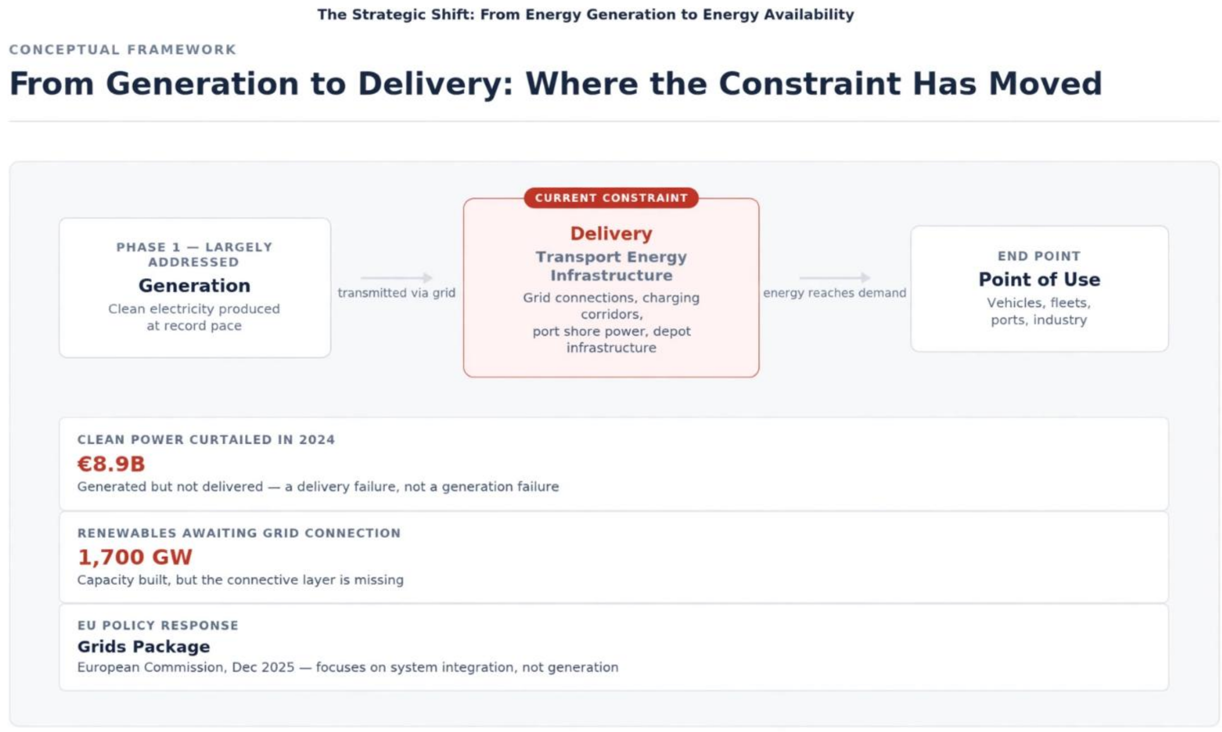


Exhibit 3.2 — Conceptual diagram: no quantitative scale. Sources: Clean Energy Wire / Aurora Energy Research (curtailment cost €8.9B, 2024); Clean Energy Wire (1,700 GW renewable connection queues); European Commission, European Grids Package (COM(2025) 1005-1007), December 2025.

3.3 From a Generation Problem to a Delivery Problem

European policy is beginning to reflect this shift in emphasis. On 10 December 2025, the European Commission presented its European Grids Package, aimed at centralising the planning of cross-border infrastructure and establishing a recurring EU-wide assessment of electricity, hydrogen and carbon infrastructure needs. The package responds directly to the curtailment, permitting and connection-queue data described above - it is, in substance, a System Integration agenda rather than a generation agenda.

Transport is a direct beneficiary, and a direct contributor to the pressure on this layer. Continued electric vehicle adoption and the growing use of heat pumps are cited by the IEA as major drivers of EU electricity demand growth through 2030, with industrial consumption - including data centres - adding further load. None of this demand growth is, on its own, a generation problem: as Section 3.1 showed, the EU is adding renewable capacity at a record pace. It is, specifically, a question of whether that energy can be delivered - across borders, through congested grid nodes, and out to the charging points, depots and fuelling infrastructure transport actually depends on - which is precisely the **Energy Availability** gap introduced in Chapter 2.

3.4 What This Means for Infrastructure Strategy

The practical implication is a reordering of strategic priorities. For most of the past decade, the central infrastructure question in European energy and transport policy was how to add clean generation capacity. The data in this chapter suggests that question is now substantially better answered than the question of how that capacity becomes usable - reliably, affordably, and at the specific points where transport, industry and logistics operate.

This is the conceptual basis for treating **Transport Energy Infrastructure (TEI)** as a distinct planning and investment category rather than a subset of either grid policy or transport policy.

The remaining chapters build on this distinction directly: Chapter 4 examines how this connective layer can function as **Productive Infrastructure**, generating value beyond simple energy delivery, and Chapter 5 sets out the fuller set of characteristics - including **Operational Resilience** - that distinguish TEI from infrastructure that sits at the intersection of energy delivery and transport demand more broadly.

Note on sources: *Generation and curtailment figures in this chapter are drawn primarily from Ember's European Electricity Review, Eurostat, the International Energy Agency, and reporting on ACER and Red Eléctrica data; methodologies for measuring curtailment differ by country and operator (see Chapter 10). Figures on EU policy response (the European Grids Package) reflect the Commission's December 2025 proposal as published; the legislative process and final scope may change.*

Sources to Chapter 3

- *IEA, Global Energy Review 2026 - Technology: Solar PV and Wind (EU renewable capacity additions, 2025).*
- *Ember, European Electricity Review 2026 - “Wind and solar generated more power than fossil fuels in the EU for the first time in 2025.”*
- *Eurostat, “47% of EU's electricity came from renewables in 2025”, March 2026.*
- *IEA / CEENERGYNEWS, “IEA: Renewables can meet EU electricity demand growth in coming years”, February 2026 (renewable share forecast to 2030; EV and heat pump demand drivers).*
- *Clean Energy Wire, “Q&A: EU Grid Package - How Europe plans to bolster the energy transition's backbone” (curtailment cost €8.9bn 2024, Aurora Energy Research; ACER fragmentation cost €11bn; European Grids Package, December 2025).*
- *Strategic Energy Europe, “Record curtailment in summer 2025: up to 11% of renewable energy was not integrated into the grid”, September 2025 (Red Eléctrica data, Spain).*

Chapter 4 - Productive Infrastructure

4.1 Two Different Meanings of “Infrastructure Productivity”

The term “infrastructure productivity” already has an established meaning in the strategy literature, and it is worth being precise about it before extending it. In its widely cited 2013 study *Infrastructure productivity: How to save $1 trillion a year*, the McKinsey Global Institute used the term to describe how efficiently infrastructure is selected, delivered and operated - better project selection, streamlined delivery, and fuller use of existing assets, which it estimated could save on the order of $1 trillion annually worldwide. That is a question about the cost side of infrastructure: building and running it more efficiently.

This report uses the term “productive infrastructure” in a related but distinct sense - not how cheaply an asset is built or operated, but how much value it actively generates once it exists. A conventional transport or energy asset is typically **passive**: it provides capacity (a charging bay, a grid connection, a substation) and is valued chiefly on utilisation of that single function. A productive asset, in the sense developed in this chapter, is designed to participate in more than one value stream at the same physical connection point.

4.2 From Passive Capacity to Active System Participation

Across Europe, a growing body of operating evidence shows what this looks like in practice for transport-energy assets specifically - not as a future possibility, but as a current commercial pattern.

Charging hubs paired with on-site battery storage are increasingly able to monetise grid flexibility in addition to selling charging energy. Nordic market analysis estimates standalone battery storage revenues of roughly **€150,000 to €250,000 per megawatt per year** in Sweden from frequency-response and reserve services, with charging-site operators capturing additional income whenever that capacity is not needed for on-site optimisation. Across European battery markets more broadly, annual revenue per megawatt from combined energy arbitrage and ancillary services is estimated to range from roughly €40,000–65,000 in lower-opportunity markets to €105,000–160,000 or more in higher-value jurisdictions, depending on how many markets an asset can participate in simultaneously.

This is not confined to standalone storage. In the United Kingdom, charge point operator Monta and flexibility specialist GridBeyond integrated more than 2,000 EV charge points into National Grid's Static Firm Frequency Response programme in 2025, allowing charging to be briefly paused during grid stress events in exchange for compensation. A 2024 study commissioned by Transport & Environment, modelled jointly with Daimler and grid operator TenneT, found that depot charging for battery-electric trucks combined with ancillary-service participation could generate **€3,000 to €10,000 of additional value per vehicle per year** for fleet operators, on top of the savings from optimised charging alone.

In each case, the same physical asset that delivers **Energy Availability** to a vehicle, fleet or depot is simultaneously functioning as a **Distributed Energy Asset** that supports **Operational Resilience** for the wider grid. The charging connection is no longer only a point of consumption; it is also a point of system participation.

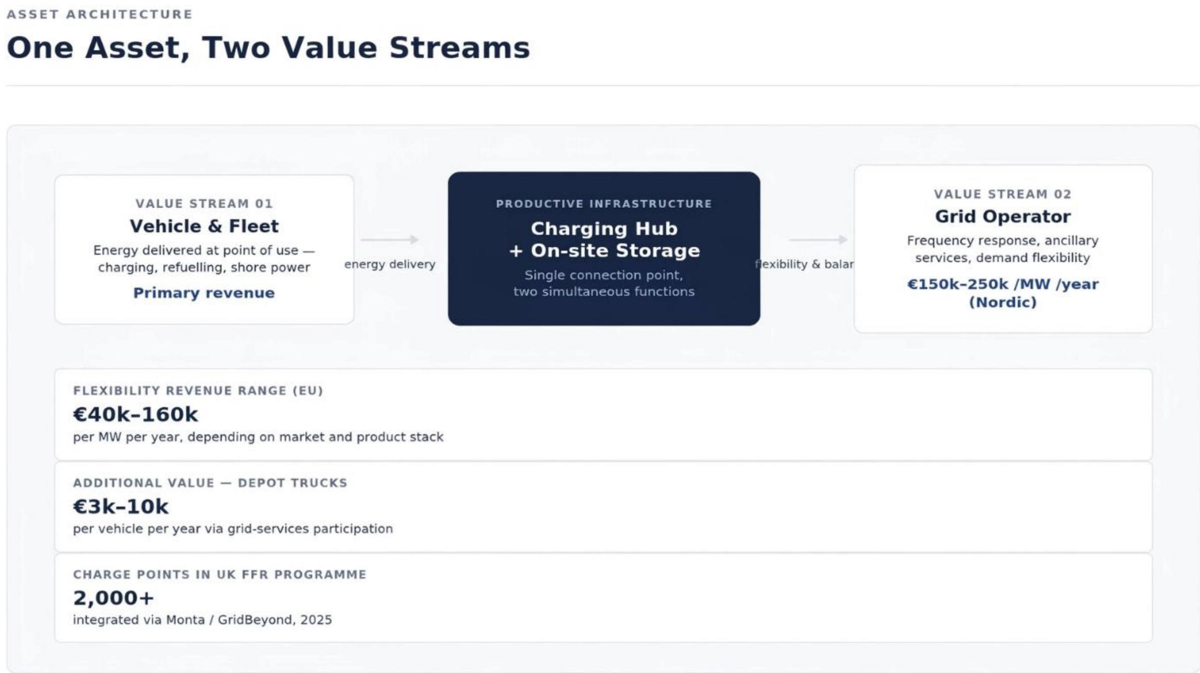


Exhibit 4.1 — Sources: FLEXeCHARGE BESS whitepaper (Nordic battery storage revenue €150k-250k/MW/yr); European BESS Index (pan-European range €40k-160k+/MW/yr); Transport & Environment / Daimler / TenneT study (depot truck V2G value, Oct 2024); FLEXeCHARGE reporting on Monta/GridBeyond UK Static Firm Frequency Response integration, 2025. Revenue figures are market estimates, not guaranteed returns — see Chapter 10.

4.3 Why This Distinction Matters for TEI

How this layer is conceived has direct consequences for how it is financed and valued. Infrastructure treated as a passive, single-purpose asset is typically valued on a regulated-asset-base logic: a fixed return on a fixed capacity, similar to a toll road or a conventional substation. Infrastructure designed and operated to participate in multiple value streams - energy delivery, flexibility and balancing services, and potentially data or site-level services - more closely resembles an operating business, with a different risk and return profile.

This distinction is the basis for treating **Capital Efficiency** in Transport Energy Infrastructure as a design choice rather than a fixed property of the asset class: the same connection point, civil works and grid interface can be engineered to capture one revenue stream or several, with materially different implications for the investment case examined in Chapter 7.

> **A caution on revenue durability:** Ancillary-service and flexibility revenues are not a fixed feature of the market. As battery storage capacity has scaled in mature markets, several flexibility products have shown signs of saturation and price compression: UK Dynamic Containment prices and German and French frequency-containment-reserve auctions have come under pressure as more storage entered those markets, and similar compression has been observed in the United States as battery deployment outpaced product capacity. A realistic assessment of "productive infrastructure" economics should treat layered revenue as a design opportunity, not a guaranteed or static income stream - a point this report returns to in Chapter 7 (Infrastructure Economics) and Chapter 10 (Limitations and Open Questions).

CONCEPTUAL FRAMEWORK

Passive vs. Productive Infrastructure: A Comparison

PASSIVE INFRASTRUCTURE	
Revenue streams	Single — One function, one revenue stream; Multiple — Layered rase:, one revenue stream
Valuation logic	Regulated-asset-base: fixed return on fixed capacity
Return profile	Predictable, low — set by regulation
Capital efficiency	Fixed — same civil works, one use case
System role	Point of consumption — energy flows through
Typical examples	Conventional substation, basic charging point

PRODUCTIVE INFRASTRUCTURE	
Revenue streams	Single — One function, one stream; Multiple — Layered revenue across functions
Valuation logic	Operating-business: return depends on design and operation
Return profile	Variable upside — depends on market access and flexibility
Capital efficiency	Design choice — same connection point, multiple value streams
System role	Node of participation — energy flows and responds
Typical examples	Charging hub + battery storage + grid-services eligibility

THE DESIGN CHOICE
The same civil works, grid connection and site can be engineered to capture one revenue stream or several. Capital efficiency in TEI is a design decision, not a fixed property of the asset class.

THE RISK CAVEAT
Flexibility and ancillary-service revenues are not guaranteed. Several European markets have shown price compression as battery storage scales. Layered revenue is a design opportunity, not a static income stream — see Chapter 10.

Exhibit 4.2 — Conceptual comparison based on analysis in Chapter 4. No new quantitative sources introduced here. Revenue risk caveat consistent with Chapter 4's caution box and Chapter 10 (Limitations and Open Questions).

4.4 Defining "Productive Infrastructure" for This Report

For the purposes of this report, **productive infrastructure** describes transport-energy assets that are designed and operated to participate actively in the broader energy system - providing flexibility, balancing or storage value that can be monetised or that reduces system cost - rather than functioning solely as a passive point of energy delivery.

This is one defining characteristic of the infrastructure class this report calls Transport Energy Infrastructure (TEI); it is not, by itself, a complete definition. Chapter 5 sets out the fuller set of characteristics - including operational resilience, system integration and asset flexibility - that together distinguish TEI from both conventional transport infrastructure and conventional energy infrastructure considered separately.

Note on sources: *Revenue figures in this chapter are drawn from market analyses and operator case studies (Nordic and pan-European battery storage markets, UK frequency-response programmes, and an EU-focused study on vehicle-to-grid potential for trucks). These are market estimates and case examples, not guaranteed returns; figures vary significantly by country, market design and time period, as the caution box above notes.*

Sources to Chapter 4

- *McKinsey Global Institute, "Infrastructure productivity: How to save $1 trillion a year", January 2013.*
- *FLEXeCHARGE, "How European EV Charging Operators Use BESS to Cut Grid Costs and Optimize Energy", March 2026 (Nordic BESS whitepaper revenue estimates).*
- *European BESS Index, market intelligence on European battery energy storage revenue ranges, 2025-2026.*
- *FLEXeCHARGE, "March 2025: EV Charging Networks Expand Across EU" (InstaVolt Winchester solar-and-battery hub; Monta / GridBeyond UK Static Firm Frequency Response integration).*

- *Transport & Environment, study on the potential of full EV-power-system integration in the EU (with Daimler and TenneT), October 2024 (vehicle-to-grid value for battery-electric trucks).*
- *Grid Forward, "The revenue illusion in battery storage (in Iberia)", March 2026 (ancillary-service revenue saturation dynamics).*
- *Energy-Storage.news, reporting on European frequency-response market saturation (FCR, aFRR, Dynamic Containment).*
- *IEA, Electricity 2026 - Flexibility chapter (role of battery storage and demand response in EU power system flexibility).*

Chapter 5 - Characteristics of Next-Generation Infrastructure

5.1 Why TEI Needs Its Own Characteristics Framework

Chapter 2 showed that transport networks, electricity grids and transport-energy delivery are planned, financed and regulated as three separate domains, none of which is designed to evaluate the combined system. Chapter 4 showed that the assets sitting at the intersection of these domains can behave differently from conventional infrastructure once in operation - generating value beyond their primary function rather than simply providing fixed capacity.

This chapter draws these observations together into a working set of characteristics that distinguish **Transport Energy Infrastructure (TEI)** from conventional transport infrastructure and conventional energy infrastructure considered separately. Four characteristics recur consistently across the evidence reviewed so far, and each is already visible - not as a future aspiration, but as a current feature of how this infrastructure is regulated and operated in Europe today.

5.2 Cross-Domain System Integration

TEI assets are governed by more than one regulatory regime simultaneously, and the regimes themselves are increasingly reaching into each other's territory. The EU's Alternative Fuels Infrastructure Regulation (AFIR) is formally a transport regulation, set out under the Fit for 55 package. Yet its obligations now extend well beyond transport: from January 2026, AFIR requires public charging points to support the ISO 15118 communication standard, including vehicle-to-grid capability, and operators must publish real-time availability and pricing data - updated within one minute - to public digital platforms. A transport regulation is, in effect, also setting technical requirements for grid communication protocols and treating charging infrastructure as a live energy-system node, not merely a roadside amenity.

This is consistent with the pattern observed in markets outside the EU. Comparable frameworks - the United States' National Electric Vehicle Infrastructure (NEVI) programme, the United Kingdom's Smart Charge Point Regulations, and the US Federal Energy Regulatory Commission's Order 2222 on distributed energy resource participation - each combine transport-deployment requirements with energy-market and data-interoperability obligations in a single instrument. No comparable asset class is required to satisfy transport regulation, energy-market rules and data-protocol standards at the same time through a single piece of infrastructure. This is the practical meaning of **System Integration** as a defining characteristic, rather than an aspiration: TEI assets sit inside several regulatory perimeters at once.

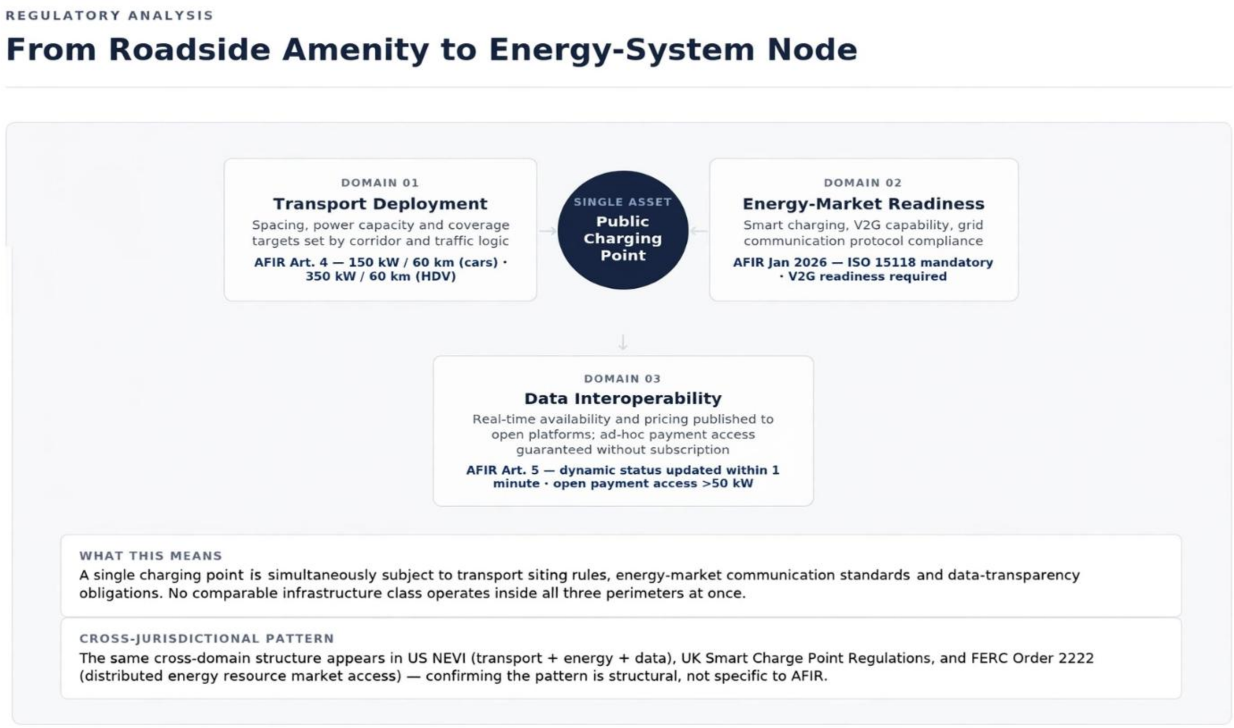


Exhibit 5.2 — Sources: AFIR (Regulation (EU) 2023/1804) and associated delegated/implementing acts, as summarised in Chapter 5, Sections 5.2 and 5.4. Comparative references: US NEVI programme; UK Smart Charge Point Regulations; FERC Order 2222.

5.3 Demand-Anchored Siting and Deployment

Conventional generation assets are sited primarily according to resource availability - where the sun, wind or water is. Conventional grid infrastructure connects two fixed points. TEI assets follow a different logic: their location is set by where transport demand physically occurs, not by where energy is cheapest to produce or easiest to transmit.

AFIR makes this explicit through binding spacing and capacity rules tied directly to traffic corridors rather than to grid or generation economics: fast-charging stations of at least 150 kW for cars and vans must be available approximately every 60 km along the TEN-T network, with stations of at least 350 kW required at the same spacing for heavy-duty vehicles, full coverage required by 2030. Required public charging capacity is similarly set in proportion to the number of vehicles in use - currently at least 1.3 kW of available public charging power per battery-electric vehicle in a given country - rather than to any property of the local grid or generation mix.

This means TEI deployment planning starts from mobility data - traffic volumes, fleet composition, corridor usage, depot locations - and works backward to the energy infrastructure required, rather than starting from available generation or grid capacity and working forward to potential uses. It is a demand-anchored, not supply-anchored, planning logic, and it requires different planning inputs and institutional coordination than either transport planning or grid planning alone typically uses.

5.4 Operational Resilience as a Built-In Requirement

Because TEI sits directly at the point of use, an outage has an immediate and visible mobility consequence in a way that a comparable outage elsewhere in the energy system often does not. EU regulation already treats this as a distinct compliance dimension rather than leaving it to operators' discretion: AFIR requires operators of public charging points to report uptime, to provide dynamic status data updated within one minute, and to guarantee ad-hoc, subscription-free payment access at every public charging point above 50 kW - obligations with no direct equivalent in conventional electricity-grid regulation, which governs reliability at the network level rather than at each individual point of consumption.

Operational Resilience, in this sense, is not an optional service-quality feature of TEI; it is a defining characteristic that is already partly codified in regulation, with the scope of these obligations continuing to expand through the delegated and implementing acts adopted since 2025.

5.5 Active, Productive System Participation

Chapter 4 set out the commercial evidence for this characteristic in detail: charging hubs paired with battery storage already generate measurable flexibility revenue in several European markets, and depot charging for electric trucks can generate additional value through grid-services participation. What has changed since that evidence was gathered is that this capability is moving from a commercial option into a regulatory baseline. The same January 2026 AFIR provision that requires ISO 15118 support also makes vehicle-to-grid readiness a mandatory technical feature of new public charging points, not an optional upgrade chosen by operators seeking additional revenue.

Taken together with the evidence in Chapter 4, this suggests that active system participation is moving from a differentiator between operators to a baseline characteristic of the asset class itself - reinforcing the case for treating TEI as a distinct category with its own economics, rather than evaluating it on the financing logic of either conventional transport or conventional energy infrastructure.

5.6 Synthesis

Four characteristics, taken together, distinguish Transport Energy Infrastructure from the conventional categories it draws on:

- Cross-Domain System Integration - governed simultaneously by transport, energy-market and data-interoperability regimes, with the boundaries between them already blurring in current regulation.
- Demand-Anchored Siting and Deployment - located and sized according to mobility patterns and corridor usage, rather than generation or grid economics.
- Operational Resilience as a Built-In Requirement - uptime, real-time status and payment access are direct regulatory obligations at the level of the individual asset, not network-level metrics.
- Active, Productive System Participation - increasingly a regulatory baseline, not only a commercial option, for generating value beyond simple energy delivery.

Chapter 6 examines how these four characteristics translate into a concrete **Infrastructure Architecture**, using Modern Mobility's deployment model as a reference case for how a TEI asset can be designed to satisfy all four simultaneously.

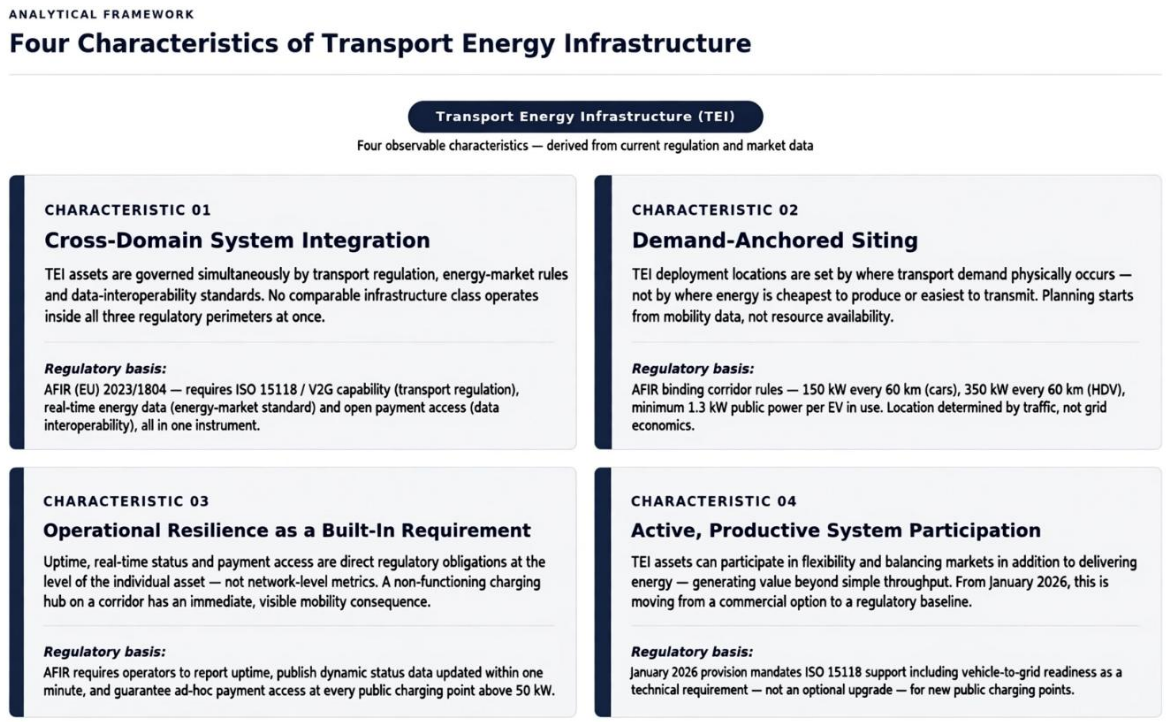


Exhibit 5.1 — Framework derived from analysis in Chapter 5. Regulatory references: AFIR (Regulation (EU) 2023/1804) and associated delegated and implementing acts as adopted through early 2026. Comparable cross-jurisdictional frameworks (US NEVI, UK Smart Charge Point Regulations, FERC Order 2222) show the same cross-domain pattern.

Note on sources: *Regulatory detail in this chapter reflects AFIR (Regulation (EU) 2023/1804) and its delegated and implementing acts as adopted through early 2026; several of these acts have phased deadlines extending to 2027 and are subject to further technical refinement. Comparative references to NEVI, the UK Smart Charge Point Regulations and FERC Order 2222 are included to illustrate a cross-jurisdictional pattern, not to suggest these frameworks are equivalent in scope or legal effect.*

Sources to Chapter 5

- *Regulation (EU) 2023/1804 of the European Parliament and of the Council on the deployment of alternative fuels infrastructure (AFIR), Official Journal of the European Union, 22 September 2023.*
- *AMPECO, “The AFIR Compliance Guide for Charge Point Operators”, March 2026 (ISO 15118 and V2G mandate timelines).*
- *Mennekes, “Ad-hoc-charging AFIR-compliant” (delegated and implementing acts, static/dynamic data obligations, 2025-2027 timelines).*
- *Codibly, “EV Charging Regulations in 2026: What CPOs Need to Implement, Not Just Know” (comparative overview of AFIR, NEVI, UK SCPR, FERC Order 2222).*
- *EVB, “EU Publishes Alternative Fuels Infrastructure Regulation (AFIR): How to Seize the Opportunity?” (per-vehicle public charging power requirement).*
- *Virta, “AFIR - Alternative Fuels Infrastructure Regulation: What you need to know” (current EU public charging point count).*

Chapter 6 - Modern Mobility as Reference Architecture

6.1 From Characteristics to Architecture

Chapter 5 set out four characteristics that distinguish Transport Energy Infrastructure from conventional transport or energy infrastructure: cross-domain system integration, demand-anchored siting, operational resilience as a built-in requirement, and active system participation. Those characteristics were derived from regulation and market data, not from any single company's technology. This chapter uses one architecture - Modern Mobility's Kinectra™ system - as a concrete illustration of how a single piece of infrastructure can be designed around all four characteristics simultaneously.

A note on scope before proceeding: this chapter deliberately does not state specific energy-yield, levelised-cost or return figures for this architecture. Preliminary commercial materials reviewed during the preparation of this report contain performance and return figures that have not yet been independently verified, and a basic energy-balance check raised questions - specifically, whether the claimed electrical output per heavy vehicle is consistent with the kinetic energy actually available from vehicle deceleration - that should be resolved by independent engineering review before such figures are published in a document addressed to public institutions and investors. This is consistent with the standard this report has applied throughout: Chapter 7 and Chapter 11 both declined to treat unverified commercial figures as established fact, and this chapter applies the same standard to the one architecture connected to this report's own publisher.

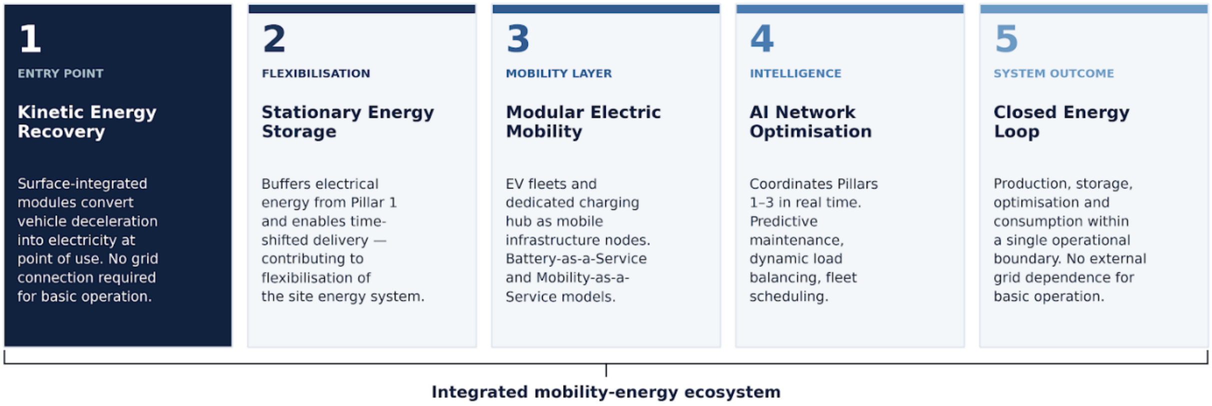
6.2 Architectural Overview

The architecture is built around a modular kinetic energy recovery system, integrated into the surface of existing transport infrastructure - road, port apron or depot pavement - at locations where heavy vehicles are already decelerating. Mechanical energy from vehicle deceleration is converted to electricity and delivered behind the meter or to a local microgrid, without requiring a new grid connection for basic operation. The system is modular (units of a fixed standard length) and installable within two to three days per location.

This sits within a five-pillar platform concept Modern Mobility describes as an integrated mobility-energy ecosystem: (1) kinetic energy recovery - the entry point examined above; (2) stationary energy storage, used to buffer electrical energy on demand and make it available on a time-shifted basis within the overall system, rather than exporting a fixed, unmanaged output - contributing, in Modern Mobility's own framing, to the flexibilisation of the energy system; (3) modular electric mobility, in which fleet vehicles and a dedicated charging hub function as mobile infrastructure nodes, including battery-as-a-service and mobility-as-a-service models; (4) AI-based network optimisation, coordinating the first three pillars in real time, including predictive maintenance and dynamic load balancing; and (5) a closed energy loop, in which production, storage, optimisation and consumption are intended to operate within a single operational boundary, with a stated design commitment to measuring and reporting system performance from the outset of operation.

PLATFORM ARCHITECTURE

Exhibit 6.2 — The Five-Pillar Platform Concept



Design intent

The five pillars form a self-reinforcing system: energy recovered at Pillar 1 is stored (2), distributed to fleets (3), optimised by AI (4) and returned to the operational boundary (5) — reducing site-level dependence on external grid infrastructure.

Tags: Local · Resilient · Scalable

Note: Technology-specific claims subject to independent verification — see Section 6.4

Exhibit 6.2 — Source: Modern Mobility platform description materials (five-pillar structure). Structural diagram only — no performance or financial data. Technology claims subject to Section 6.4 verification.

6.3 Mapping the Architecture to the Four TEI Characteristics

Demand-anchored siting. This is the characteristic the architecture satisfies most directly, and by design rather than by claim. Installation locations - port entrance gates, depot access points, toll plazas, security checkpoints - are exactly the locations where heavy-vehicle traffic is already required to decelerate for operational reasons unrelated to energy generation. Unlike a solar or wind asset, whose location is chosen for resource availability, this architecture's location is fixed entirely by where vehicles already brake. This is a structural property of the design, independent of any disputed output figure.

Cross-domain system integration. The architecture is physically a transport-infrastructure component (a road or apron surface element, subject to the same civil and traffic considerations as the pavement around it) and an energy-generation asset at the same time, feeding directly into a site's own electricity use or, with appropriate connection, the local grid. This dual nature is the same characteristic Chapter 5 identified in AFIR's treatment of public charging points - a single asset governed by more than one infrastructure logic at once.

Operational resilience. Because the mechanism is driven by vehicle movement rather than by sunlight or wind, the architecture is designed to be unaffected by weather conditions, and modular construction is intended to allow individual units to be replaced without shutting down the surrounding installation. These are design properties of the mechanism's operating principle, not figures requiring independent energy-output verification.

Active system participation. The broader five-pillar platform concept - pairing kinetic energy recovery with stationary storage, and eventually with smart mobility and AI optimisation layers - follows the same logic Chapter 4 described for charging hubs paired with battery storage. Modern Mobility describes the storage pillar specifically as contributing to the flexibilisation of the energy system: buffering electrical energy and making it available on a time-shifted basis within the system, rather than exporting a fixed, unmanaged output. This is the same structural feature, described here only in functional terms, that supported the case for active participation in Chapter 4. As in that chapter, whether any specific installation achieves a level of output worth time-shifting depends on the verification described in Section 6.1, and the storage technology's own composition and comparative performance claims are subject to the same independent-verification standard and are not reproduced here.

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6.4 What Remains to Be Independently Verified

In keeping with this report's standard of treating its own claims with the same scrutiny applied to third-party data, the following must be resolved before specific performance or financial figures for this architecture can be included in this report:

- An independent energy-balance and engineering review of the claimed electrical output per vehicle, reconciling it against the kinetic energy physically available from vehicle deceleration at the stated traffic speeds and vehicle weights.
- Independent verification of any pilot or reference-site operating data, including third-party measurement rather than vendor-reported figures.
- Verification of the patent position, manufacturing capacity and quality certifications referenced in internal materials but not yet independently confirmed.

- A reconciliation of the differing per-vehicle energy figures that have appeared in different internal materials reviewed during the preparation of this report.
- Independent verification of the stationary storage technology's specific composition and comparative performance claims (for example, chemistry and cycle life relative to incumbent battery technologies), which are not reproduced in this chapter pending the same standard of review applied to the kinetic recovery figures.

Once these are resolved, this chapter will be revised to include specific performance and economic figures, on the same evidentiary standard applied to every other chapter in this report.

Note on sources and status: *The architectural description in Section 6.2 reflects Modern Mobility's internal platform materials and an ecosystem overview graphic reviewed during the preparation of this report, which structures the platform as five pillars rather than the four-pillar description used in an earlier internal summary. No performance, cost or return figures, and no storage-technology composition or comparative performance claims, are reproduced in this chapter pending the independent verification described in Section 6.4. This is the most conservative chapter in the report by design, and intentionally so, given that it concerns the publisher's own technology rather than third-party or public-sector data.*

Sources to Chapter 6

- *Modern Mobility, internal platform description materials (five-pillar concept), as provided for the preparation of this report.*
- *Modern Mobility, project-related presentation material provided for the preparation of this report, cited exclusively for descriptive reference on system architecture and intended use cases; performance and return figures from this source are excluded pending the verification specified in Section 6.4.*
- *Modern Mobility, ecosystem overview graphic ("The Five-Pillar Ecosystem of Modern Mobility"), as provided for the preparation of this report - referenced for the platform's five-pillar structure only; technology-specific composition and performance claims shown in the source graphic are not reproduced pending independent verification.*

Chapter 7 - Infrastructure Economics

7.1 Three Established Financing Logics

Infrastructure investors typically sort assets into risk-and-return bands that determine how they are financed, who finances them, and at what cost of capital. Three bands recur across investor research:

- Core infrastructure - regulated, monopolistic, long-duration assets such as power and water utilities, with predictable, often inflation-linked cash flows. Industry surveys typically place target returns in this band at the low single digits to low double digits, depending on methodology - for example, roughly 4-6% by one widely used framework, or higher when measured on a private-fund IRR basis that includes leverage and fees.
- Core-plus infrastructure - assets such as toll roads, airports and seaports that retain essential-service characteristics but carry more usage and market-cycle exposure. Target returns are typically cited in the high single digits to mid-teens (commonly 8-12%, with some frameworks citing 11-16%), with capital appreciation playing a larger role alongside income.
- Value-add and opportunistic infrastructure - assets requiring active development, platform-building or operational transformation, including much of renewables, battery storage and digital infrastructure. Target returns are typically cited from the mid-teens upward - figures in recent investor research range from roughly 14-18% to 20% or more, again depending on whether the figure is gross or net, fund-level or project-level.

These figures vary meaningfully across sources because they reflect different methodologies - gross versus net returns, fund-level versus project-level, and different vintage years. They are presented here as *illustrative bands*, not as a single authoritative scale, and Chapter 10 returns to this caveat.

7.2 Where TEI Sits: A Hybrid Logic

Transport Energy Infrastructure does not map cleanly onto any one of these three bands, for the reasons set out in Chapters 4 and 5. The base layer of a TEI asset - the grid connection, civil works, hardware and site - behaves much like a core or core-plus asset: it is long-lived, its location and minimum specification are largely set by binding regulatory targets such as AFIR's corridor spacing rules, and its primary revenue (energy delivery) is comparatively predictable once a site is operational. The layered revenue described in Chapter 4 - flexibility, balancing and ancillary-service income - behaves more like a value-add or merchant asset: higher growth potential, but also exposed to the market-saturation risk flagged in that chapter's caution box.

This is consistent with how institutional investors are already describing a broader category of assets that resist simple classification. Industry research from Roland Berger's 2026 infrastructure investment outlook observes that “hybrid infrastructure assets, which don't fit traditional categories,” are increasingly attracting both core-plus and value-add capital because of their mission-critical services and durable underlying demand, even where individual revenue contracts are shorter or more variable. TEI, as defined in this report, is a clear example of this pattern - investors do not yet have a dedicated benchmark for it, but the underlying asset behaviour is already recognised.

Exhibit 7.1 — Return ranges are illustrative bands drawn from multiple industry sources (Chronograph, GreenBridge Infrastructure, InfraRed Capital Partners, Cambridge Associates) using different methodologies — not a single authoritative benchmark. TEI positioning is analytical, not a fund classification. See Chapter 10 for methodological limitations.

7.3 The Role of Blended and Public Finance in Closing the Gap

Given the funding gaps set out in Chapter 2, a meaningful share of European transport-energy buildout today is enabled by blended public-private finance rather than private capital alone. The European Investment Bank's InvestEU programme - which aims to mobilise more than **€372 billion** of investment over 2021-2027, backed by a €26.2 billion EU budget guarantee - has been used specifically to de-risk early-stage charging infrastructure companies.

In September 2025 the EIB provided **€17.5 million** in InvestEU-backed venture debt to Greek charge point operator Joltie to fund roughly 2,200 new charging points in Greece and Cyprus by 2029. In January 2026 it extended a **€35 million** InvestEU-backed loan to Eleport to deploy more than 250 ultra-fast charging hubs across eight Central and Eastern European countries by 2028. On the grid side, the EIB committed a record **€11 billion** in new grid financing in 2025 - nearly triple its 2023 level - as part of a wider €100 billion annual financing ceiling.

In each case, the public instrument did not replace private capital; it absorbed early-stage or first-loss risk so that private investors could underwrite the remainder on more conventional terms. This is the same logic that closes the gap between a core-style base asset and a value-add-style revenue layer described in Section 7.2 - and it is a logic EIB and InvestEU already apply to individual charging and grid projects, even though no instrument yet treats Transport Energy Infrastructure as a defined category in its own right.

7.4 Implications for Capital Structure

Treating TEI as a single, undifferentiated asset class would force an artificial choice between underwriting it conservatively (undervaluing the productive-infrastructure upside described in Chapter 4) or underwriting it aggressively (underpricing the regulatory and demand certainty described in Chapter 5). A layered capital structure avoids this trade-off by matching each part of the asset to the financing logic it already resembles:

- Senior infrastructure debt against the base delivery function - long-tenor, lower-cost capital secured against demand that is, in large part, set by binding regulatory targets rather than market forecasts.
- Blended or guarantee-backed capital, of the kind already deployed through InvestEU, to absorb early-stage development and connection risk before an asset reaches stabilised operation.
- Value-add equity capturing the upside from active system participation - flexibility and ancillary-service revenue - with full awareness of the saturation risk described in Chapter 4.

This is the practical content of **Capital Efficiency** as applied to TEI: not a single optimal financing structure, but a design choice that allocates each layer of risk and return to the capital that is best suited to bear it.

Exhibit 7.2 — Return ranges are illustrative. Sources: EIB press releases (Joltie, Eleport, grid financing 2025); EVBoosters CPO financing roundup (IONITY, Powerdot, GreenWay); Roland Berger Infrastructure Investment Outlook 2026; Chronograph, Cambridge Associates (return band estimates). See Chapter 10 for methodological caveats on return comparability.

Note on sources: *Return figures in Section 7.1 are drawn from several independent industry sources (Chronograph, GreenBridge Infrastructure, InfraRed Capital Partners, Cambridge Associates) that use different methodologies and are not directly comparable; they are included to establish an order of magnitude, not a precise benchmark. The EIB/InvestEU examples in Section 7.3 are individual charging- and grid-infrastructure transactions, cited as evidence of an existing financing pattern; they do not constitute a dedicated TEI financing instrument, which does not yet exist. Chapter 10 returns to both points.*

Sources to Chapter 7

- *Chronograph, “Core, Core Plus, Value-Add, and Opportunistic Infrastructure: A Deep Dive”, 2025.*
- *GreenBridge Infrastructure, “Investor Return Expectations”, 2026.*
- *InfraRed Capital Partners, “Infrastructure Strategic Outlook 2025”, December 2024/2025.*
- *Cambridge Associates, “Powering the Future: Infrastructure Trends, Performance, and Portfolio Impact”, November 2025.*
- *Roland Berger, “Infrastructure Investment Outlook 2026”.*
- *European Investment Bank, press release: “EIB invests €17.5 million under InvestEU to expand electric vehicle charging network in Greece and Cyprus”, September 2025.*
- *Highways Today / European Investment Bank, “InvestEU Helps Scale High Power EV Charging From the Baltic to the Adriatic” (Eleport, €35 million), January 2026.*
- *European Investment Bank, “Investment is needed to upgrade Europe's electricity grids” (record €11 billion grid financing, 2025); EIB Group 2025 Activity Report (€100 billion financing ceiling).*

Chapter 8 - Deployment Scenarios

8.1 One Category, Three Operating Environments

Chapter 5 set out four characteristics that distinguish Transport Energy Infrastructure as a category: cross-domain system integration, demand-anchored siting, operational resilience, and active system participation. These characteristics do not weigh equally in every setting. This chapter examines three deployment contexts - motorway and TEN-T corridor charging, port and maritime electrification, and depot-based fleet charging - chosen because they correspond directly to three of the institutional audiences this report addresses: motorway concession operators, port authorities, and the logistics and fleet operators whose infrastructure investment decisions increasingly involve all of them. In each case, a different characteristic from the Chapter 5 framework dominates, even though the underlying asset class is the same.

8.2 Motorway and TEN-T Corridor Charging

AFIR sets binding, corridor-based targets for this context: fast-charging stations for cars and vans of at least 150 kW must be available every 60 km along the TEN-T core road network, with minimum site power rising from 400 kW to 600 kW by the end of 2027. For heavy-duty vehicles, AFIR requires charging points of at least 350 kW at TEN-T corridor locations, with required spacing and aggregate site power increasing progressively through 2030.

Deployment is under way but materially behind the scale required. As of November 2025, the European Alternative Fuels Observatory recorded **937 heavy-duty charging locations across Europe, of which only 313 were equipped with at least one charger meeting the 350 kW AFIR threshold**. A 2025 ICCT analysis projects that the EU-27 truck fleet will require between 22 and 28 GW of total charging power by 2030, and that AFIR's binding targets - even if fully implemented - will cover only **50 to 70 percent of projected public charging needs** at the EU-27 level, falling to 35-45 percent across the wider comprehensive TEN-T network.

One visible industry response is Milence - a joint venture between Daimler Truck, Traton and the Volvo Group - which has set a target of 1,700 public truck charging points by 2027, including 284 Megawatt Charging System (MCS) points across 71 locations, and has already deployed MCS-capable hubs at the Port of Antwerp-Bruges, Zwolle and Landvetter as part of a planned charging corridor between Antwerp and Stockholm. This is cited here as one current example of how a corridor build-out is being approached in practice by an industry consortium, not as an endorsement of a particular technical solution.

In this context, **demand-anchored siting** is the dominant characteristic - locations are set almost entirely by AFIR's distance and power rules rather than by grid convenience - closely followed by **operational resilience**: a non-functioning charging hub on a long-haul corridor has an immediate, visible effect on freight schedules in a way few other infrastructure failures do.

Exhibit 8.2 — Sources: EAFO HDV Charging Infrastructure Data Update (Nov 2025); ICCT, "Charging infrastructure needs for BEV trucks in the EU by 2030" (Oct 2025); TT Club / Bunker Index analysis (Jan 2026); ESPO port OPS data (2024); IEA Global EV Outlook 2026; Transport & Environment / Daimler / TenneT (V2G value, Oct 2024). Different sources use different scope definitions — see Chapter 10.

8.3 Port and Maritime Logistics Electrification

From 1 January 2030, FuelEU Maritime requires container and passenger ships above 5,000 gross tonnage calling at core TEN-T ports to connect to onshore power supply (OPS) - or use an equivalent zero-emission technology - for at least **90 percent of port calls**. AFIR separately requires the relevant TEN-T ports to have OPS installed by the end of 2029. Estimates of the resulting electricity demand vary by methodology, converging on a policy-relevant range of roughly **6 to 13 TWh per year across EU ports**, with a central compliance-aligned estimate of about 10.6 TWh per year.

Current readiness lags the 2030 deadline by a wide margin. The European Sea Ports Organisation reported in 2024 that **58 percent of EU ports have some OPS capability**, but a mid-2025 analysis by transport insurer TT Club found that only **20 percent of the specific OPS connections required to meet the 2030 mandate** were installed or contracted. Part of the difficulty is scale: a large cruise ship can require up to 16 MW of continuous power at berth and a container ship around 7.5 MW - compared with the 1-2 MW typically drawn by a port's existing ship-to-shore cranes - and grid upgrades of this size commonly take five to fifteen years to permit and build, a timeline that does not comfortably fit inside the 2030 deadline. In response, the European Commission approved a **€570 million Italian state aid scheme** in June 2025 specifically to incentivise shore-power use - a port-sector example of the blended public-private financing pattern discussed in Chapter 7.

In this context, **cross-domain system integration** is the dominant characteristic: a port electrification project simultaneously involves maritime regulation (FuelEU Maritime), transport-infrastructure regulation (AFIR), and grid-capacity planning that exceeds what most port authorities' existing electrical infrastructure was ever designed to carry.

8.4 Depot-Based Fleet Electrification

Most heavy-duty vehicle charging in Europe will not happen on public corridors at all. The IEA's 2026 Global EV Outlook projects that depot charging for trucks and buses will grow to roughly **1.3 million units by 2035** under its main scenario, compared with only around **27,000 public heavy-duty charging points** over the same period. Depots, not corridors, will carry most of the charging volume; corridors remain strategically necessary for the minority of long-haul journeys that exceed a single battery range, which is precisely why AFIR regulates them so specifically.

Depot charging also has a materially different operational profile. Vehicles typically return to a depot on a predictable daily schedule, charge overnight or between shifts, and are managed through fleet software that already tracks vehicle status, route assignments and energy needs. This scheduling predictability is exactly the condition under which the active-participation case described in Chapter 4 is strongest: a 2024 study for Transport & Environment, modelled with Daimler and TenneT, found that combining depot charging with grid-services participation could generate an estimated €3,000 to €10,000 of additional value per electric truck per year, because depot charging windows can be shifted within a planned schedule far more easily than charging at a public highway stop, where drivers expect to plug in and leave as quickly as possible.

In this context, **active, productive system participation** is the dominant characteristic: the same predictability that makes depot charging operationally simple is what makes it the most commercially attractive setting for the flexibility revenue described in Chapter 4.

8.5 Synthesis: One Category, Different Emphasis

Three deployment contexts, three different dominant characteristics from the same underlying framework:

- Motorway / TEN-T corridor charging — dominated by demand-anchored siting and operational resilience; financing and policy attention should prioritise speed of build-out against binding spacing targets and uptime guarantees.
- Port and maritime electrification — dominated by cross-domain system integration; the binding constraint is coordinated planning across maritime, transport and grid regulation, not any single domain's funding gap.
- Depot-based fleet charging — dominated by active, productive system participation; this is the context in which the Chapter 4 case for layered revenue is most directly applicable today.

This has a direct implication for Chapters 9 and 11: a single policy or financing approach applied uniformly across all three contexts would underweight whichever characteristic is least dominant in that setting. Chapter 9 considers what this means for policy design, and Chapter 11 returns to it from the investor's perspective.

DEPLOYMENT ANALYSIS

Three Deployment Contexts, Three Dominant Characteristics

TEI Characteristic	CONTEXT 01 Motorway / TEN-T Corridor	CONTEXT 02 Port & Maritime	CONTEXT 03 Depot-Based Fleet
Cross-Domain Integration	●●○ Medium — AFIR + grid coordination	●●● ★ Dominant — maritime + transport + grid simultaneously	●○○ Lower — energy + fleet management
Demand-Anchored Siting	●●● ★ Dominant — AFIR spacing rules set location by law	●●○ High — port call patterns drive siting	●●○ High — depot follows fleet routes
Operational Resilience	●●● ★ Dominant — outage has immediate freight schedule impact	●●○ High — vessel schedules are time-critical	●●○ Medium — predictable schedule reduces exposure
Active Participation	●○○ Lower — rapid turnaround limits flexibility windows	●●○ Medium — OPS scale creates potential if storage added	●●● ★ Dominant — predictable schedule enables V2G & flexibility

●●● High / Dominant (★) ●●○ Medium ●○○ Lower Blue shading = dominant characteristic for that context

MOTORWAY / TEN-T
Speed of build-out
Demand-Anchored Siting
Binding AFIR corridor rules set demand — permitting and grid connection are the binding constraints

PORT & MARITIME
Coordination across domains
Cross-Domain Integration
FuelEU Maritime + AFIR + grid upgrade (5–15 yrs) must align before 2029 deadline

DEPOT-BASED FLEET
Active revenue layering
Active Participation
Predictable charging windows = strongest V2G case today; €3k–10k per truck per year

Exhibit 8.1 — Synthesis based on analysis in Sections 8.2–8.5 and the TEI characteristics framework from Chapter 5. Dominance ratings are qualitative assessments based on AFIR, FuelEU Maritime, EAFO HDV data (Nov 2025), IEA Global EV Outlook 2025/2026, and Transport & Environment/Daimler/TenneT (Oct 2024).

Note on sources: *Figures in this chapter draw on AFIR and FuelEU Maritime as adopted, ICCT and IEA modelling, EAFO infrastructure tracking data, and individual project and funding examples (Milence, Italy's shore-power scheme). Different sources use different scope definitions (EU-27 vs. wider Europe, public vs. total charging stock) and different forecast years; figures are presented as the most recent and best-attributed estimate available for each point, not as a single reconciled dataset.*

Sources to Chapter 8

- *IEA, Global EV Outlook 2025 and 2026 - Electric vehicle charging chapters (AFIR car-charging targets; depot vs. public HDV charger projections).*
- *International Council on Clean Transportation (ICCT), “Charging infrastructure needs for battery electric trucks in the European Union by 2030”, October 2025.*
- *European Alternative Fuels Observatory (EAFO), “Heavy-Duty Electric Truck Charging Infrastructure in Europe: Data Update”, November 2025.*
- *Eleport, “The 8 Most Important EV Charging Trends 2025” (Milence MCS corridor targets and deployments).*
- *Sustainable Ships, “Shore power electricity demand in EU ports from 2030 onwards”, March 2026.*
- *European Sea Ports Organisation (ESPO), 2024 data on port OPS capability, as cited by e1 Marine.*
- *TT Club, analysis reported by Bunker Index, “Ports face 2030 deadline for shore power as only 20% of EU connections installed”, January 2026.*
- *Offshore Energy, “Fit for (sustainable) future: Onshore power supply gaining ground in European ports” (European Commission approval of Italian shore-power state aid scheme, June 2025).*
- *Transport & Environment, study on the potential of full EV-power-system integration in the EU (with Daimler and TenneT), October 2024 (as also cited in Chapter 4).*
- *Smart Freight Centre, “Guidelines - Charging Infrastructure for Truck Depots”.*

Chapter 9 - Policy Implications

On 10 December 2025, the European Commission published its European Grids Package a proposal to revise the Trans-European Networks for Energy (TEN-E) Regulation and a new Permitting Acceleration Directive. It is, to date, the clearest sign that EU policy is moving in the direction this report describes: toward treating delivery infrastructure, not only generation, as the central planning problem. The package is still at the proposal stage and will go through the ordinary legislative procedure with the European Parliament and Council, a process expected to take several months at minimum. Within that frame, four specific implications follow from the analysis in Chapters 2 through 8.

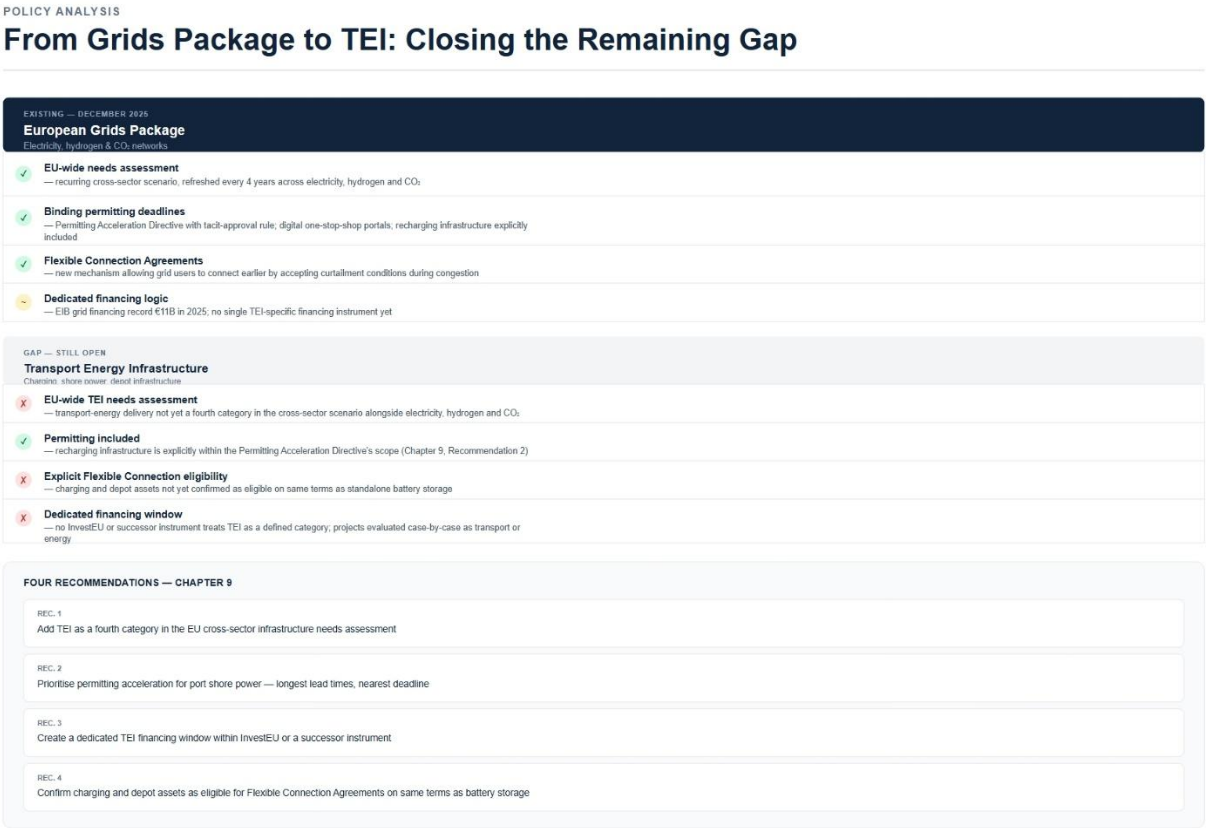

Exhibit 9.1 — Sources: European Commission, European Grids Package (COM(2025) 1005-1007), 10 December 2025; Herbert Smith Freehills Kramer (Jan 2026); Eurelectric (Dec 2025); Florence School of Regulation (Feb 2026). Note: the Grids Package remains a legislative proposal subject to European Parliament and Council negotiation.

9.1 Recognise TEI as a Planning Category, Not a By-Product of Grid Planning

9.2 Prioritise Permitting Acceleration Where the Evidence Shows It Is Most Needed

The Permitting Acceleration Directive introduces binding EU-level time limits for permitting procedures covering, among other categories, EV charging stations, and provides for tacit approval (“positive silence”) where authorities miss the deadline, alongside mandatory digital one-stop-shop permitting portals. This directly targets the permitting delays identified throughout this report - including the finding in Chapter 2 that more than half of transmission projects needed by 2030 are still awaiting permits, and the finding in Chapter 8 that port electrification projects routinely face five-to-fifteen-year grid-upgrade timelines against a 2030 compliance deadline.

Recommendation: given the scale mismatch identified in Chapter 8 - port electrification facing the longest permitting timelines against one of the nearest binding deadlines (2029-2030) - Member States and the Commission should prioritise the rollout of one-stop-shop permitting and tacit-approval mechanisms for port onshore power supply connections specifically, rather than leaving sequencing to general administrative capacity.

9.3 Formalise the Blended-Finance Pattern Already in Use

Chapter 7 documented that the EIB and InvestEU already apply a blended public-private financing logic to individual charging and grid transactions - the Joltie and Eleport financings, and the EIB's record €11 billion in 2025 grid financing, among them. What does not yet exist is a financing instrument that recognises Transport Energy Infrastructure as a category in its own right, with underwriting criteria built around the characteristics set out in Chapter 5 rather than treated case by case as either a transport project or an energy project.

Recommendation: the Commission and EIB should consider whether a dedicated TEI window - within InvestEU or a successor instrument - could reduce the transaction costs of evaluating each charging, depot or port-electrification project individually against either transport or energy criteria, and provide capital markets with a clearer, more durable signal than a sequence of individual transactions.

9.4 Ensure TEI Assets Can Participate in Flexibility Markets on Comparable Terms

Chapter 4 showed that the commercial case for treating TEI as productive infrastructure depends on charging and depot assets being able to access flexibility and balancing markets, and Chapter 8 showed that depot charging is the deployment context where this case is strongest today. The Grids Package itself introduces **Flexible Connection Agreements** - a mechanism allowing a grid user to connect on the condition that it can be curtailed during congestion, in exchange for faster or cheaper connection. This is, in principle, exactly the kind of instrument that could let a charging hub or depot connect sooner by accepting curtailment obligations, while still being eligible to monetise flexibility outside congestion periods.

Recommendation: regulators should clarify, as Flexible Connection Agreements and related grid-connection guidance are finalised, that charging and depot assets are explicitly eligible on the same terms as standalone battery storage — not only because this would ease the connection-queue pressure described in Chapters 2 and 3, but because it is a precondition for the productive-infrastructure economics this report describes in Chapter 4 and Chapter 7.

Note on sources and status: *The European Grids Package (COM(2025) 1005, 1006 and 1007) was published on 10 December 2025 and remains a legislative proposal; the TEN-E revision and Permitting Acceleration Directive must still pass through the European Parliament and Council, and analysts covering the package note unresolved political disagreement among Member States over planning control, congestion-income allocation and cost-sharing. The recommendations in this chapter are framed against the package as proposed; their relevance may need to be revisited once the final adopted text is available. Chapter 10 returns to this as a methodological limitation of the analysis.*

Sources to Chapter 9

- European Commission, European Grids Package: Communication, TEN-E revision proposal (COM(2025) 1005/1006) and Permitting Acceleration Directive proposal (COM(2025) 1007), 10 December 2025.
- Herbert Smith Freehills Kramer, “The EU Grids Package: A Blueprint for Europe's Future Energy Infrastructure”, January 2026.
- Eurelectric, “Under the EU policy tree: the European Grids Package unwrapped”, December 2025 (Flexible Connection Agreements; Energy Highways).
- Florence School of Regulation, “The European Grids Package at a Glance: Mapping the Proposed Changes”, February 2026.
- Clean Energy Wire, “Q&A: EU Grid Package — How Europe plans to bolster the energy transition's backbone” (as also cited in Chapter 3).
- European Macro Policy Network, “How the EU Grids Package Can Succeed”, April 2026 (political economy of Member State disagreement).
- SolarPower Europe, statement on the European Grids Package, December 2025.

Chapter 10 - Limitations and Open Questions

Every preceding chapter has flagged specific methodological caveats alongside the evidence it presented. This chapter draws those caveats together, and goes one step further: it sets out the strongest counter-arguments to this report's central thesis, rather than leaving them to be raised only by readers who disagree.

10.1 Methodological Limitations

Cross-source comparability. Many of the figures cited in this report - on infrastructure funding gaps (Chapter 2), curtailment costs (Chapter 3), investor return bands (Chapter 7), and charging-infrastructure deployment (Chapter 8) - are drawn from sources that use different scopes (EU-27 versus wider Europe), different time horizons, and different methodologies (gross versus net returns, fund-level versus project-level, public versus total charging stock). Where this report cites a single figure, it should be read as the best available estimate from a credible source for that specific point, not as a reconciled, single-methodology dataset. A reader using these figures for investment or policy modelling should verify them against primary sources for the specific scope and year required.

Regulatory and political uncertainty. A substantial part of the case made in Chapters 5, 8 and 9 rests on EU regulation that is either recently adopted and still being phased in (AFIR and its delegated and implementing acts, with deadlines extending to 2027 and beyond) or not yet adopted at all (the European Grids Package, published as a legislative proposal in December 2025, with analysts already noting unresolved disagreement among Member States over planning control, congestion-income allocation and cost-sharing). Both could change materially - in scope, in timeline, or in final form - before they take full legal effect. The analysis in this report reflects the regulatory position as proposed or adopted at the time of writing.

Revenue and return assumptions. The “productive infrastructure” case in Chapter 4, and the capital-structure logic built on it in Chapter 7, depend on flexibility and ancillary-service revenue that this report's own caution box already flagged as exposed to market saturation and price compression as more storage and flexible assets enter the same markets. These figures should be treated as illustrative of a commercial pattern that exists today, not as a forecast of the revenue any specific future asset will earn over its operating life.

National and sub-national variation. Figures aggregated at the EU-27 level can mask wide variation between Member States. The ICCT's analysis of AFIR truck-charging coverage, cited in Chapters 5 and 8, found that the regulation's binding targets cover only 30-50 percent of projected public charging needs in roughly half of Member States, while in others - such as Romania - the target is roughly twice the projected need. A deployment or financing strategy built on EU-27 averages could be significantly wrong for any specific national or regional market.

10.2 A Serious Counter-Position: Is “Generation vs. Availability” a False Dichotomy?

This report's central thesis, set out in Chapter 3, is that the binding constraint on Europe's energy transition has shifted from generation to availability. A serious objection to this framing is that it understates how unfinished the generation problem still is. Chapter 3 itself noted that when wind and hydro output fell in 2025, the resulting shortfall was met by burning more gas - not by drawing on newly installed solar and wind capacity, because that capacity was concentrated in different hours and locations than where the shortfall occurred. A critic could reasonably argue that this is evidence of a continuing *generation adequacy and firmness* problem - the absence of enough dispatchable or long-duration clean capacity to cover periods of low renewable output - rather than, or in addition to, a delivery problem. On this view, prioritising delivery infrastructure (and TEI specifically) risks diverting policy and capital attention from a generation-side gap that has not, in fact, been closed.

This report's response is that the two problems are not mutually exclusive, and that the evidence in Chapters 2 and 3 - record curtailment costs alongside record capacity additions - is specifically evidence of energy that was generated but could not be delivered, which is a different failure mode from energy that was never generated at all. Both gaps may need to be closed simultaneously. But this is a genuine point of contention in the energy-policy literature, and a reader should weigh it rather than take the generation-to-availability framing as a settled fact.

10.3 A Serious Counter-Position: Is “Transport Energy Infrastructure” Premature Category Creation?

A second serious objection is institutional rather than technical. Infrastructure investors already have a working vocabulary for the assets this report discusses - core, core-plus and value-add infrastructure, as set out in Chapter 7 - and a sceptical reader could argue that bundling transport networks, electricity grids and charging or shore-power infrastructure into a single new category does more analytical work for the entity proposing the category than for the investor or policymaker using it. Sovereign-backed transport megaprojects, regulated grid assets and merchant-exposed charging hubs have, on this view, sufficiently different risk profiles that grouping them risks *obscuring* rather than clarifying investment and policy decisions - and new-asset-class claims of this kind are common enough in infrastructure strategy literature that institutional readers have reason to be cautious by default.

This report's response is that Chapter 5's four characteristics - cross-domain integration, demand-anchored siting, operational resilience as a built-in requirement, and active system participation - are observable in current regulation and operating data, not asserted by analogy. Whether that justifies a distinct category, however, or whether it is better handled as a set of due-diligence considerations applied within existing core-plus and value-add frameworks, is a legitimate open question that this report does not consider fully resolved. The case for TEI as a category is strongest as a planning and policy framework (Chapter 9); it is more provisional as a claim about how capital markets should classify these assets (Chapter 7).

10.4 What Would Change This Analysis

In the interest of intellectual honesty, several developments over the next one to three years would materially affect the conclusions of this report, and are worth monitoring directly:

- If the European Grids Package is substantially narrowed or delayed during trilogue negotiations, the policy recommendations in Chapter 9 - particularly the case for a TEI-specific needs assessment - would need to be revisited.
- If flexibility-market revenues for batteries and charging assets continue to compress as more capacity enters European markets, the productive-infrastructure economics in Chapter 4 and the capital-structure logic in Chapter 7 would need to rely more heavily on the base delivery layer alone, with corresponding implications for expected returns.
- If renewable curtailment costs decline meaningfully as grid investment catches up - which is the explicit goal of the Grids Package - the urgency of the availability argument in Chapter 3 would correspondingly diminish, which this report would regard as a sign of progress rather than a contradiction of its thesis.

LIMITATIONS FRAMEWORK

What Would Change This Analysis

WATCH INDICATOR 01

Grids Package Legislative Outcome

If the European Grids Package is substantially narrowed or delayed during trilogue, the policy recommendations in Chapter 9 — particularly the case for a TEI-specific needs assessment — would need to be revisited. Analysts already note unresolved Member State disagreement over planning control, cost-sharing and congestion-income allocation.

TIMELINE 2026–2027 — European Parliament and Council negotiation period

WATCH INDICATOR 02

Flexibility Market Revenue Trend

If flexibility and ancillary-service revenues for batteries and charging assets continue to compress as more capacity enters European markets, the productive-infrastructure economics in Chapter 4 and capital-structure logic in Chapter 7 would rely more heavily on the base delivery layer alone — reducing expected returns for the equity tranche.

TIMELINE 2027–2028 — first multi-year track records for CPO debt portfolios will be visible

WATCH INDICATOR 03

Curtailment Cost Trend

If renewable curtailment costs decline meaningfully as grid investment catches up — which is the explicit goal of the Grids Package — the urgency of the availability argument in Chapter 3 would correspondingly diminish. This report would regard that outcome as a sign of progress, not a contradiction of its thesis.

TIMELINE 2029–2030 — AFIR and FuelEU Maritime deadlines provide a natural assessment point

Note on this chapter: These three indicators are offered as explicit falsifiability tests for the central argument of this report — not as predictions. A report that cannot specify what evidence would change its conclusions is a report that has not been honest about the limits of its own analysis.

Exhibit 10.1 — Conceptual framework based on analysis in Chapter 10. No new quantitative sources introduced. Indicators derived from the source caveats disclosed throughout Chapters 2–9.

Note on this chapter: *This chapter does not introduce new factual claims; it synthesises and cross-references the source caveats already disclosed in Chapters 2, 3, 4, 5, 7, 8 and 9, and articulates counter-positions to this report's own thesis. Readers using this report for investment or policy decisions should treat Sections 10.2 and 10.3 as open questions, not as objections this report claims to have fully resolved.*

Chapter 11 - Investment Perspective

11.1 The Asset Class Already Exists — Investors Just Aren't Naming It Yet

Chapter 10 raised a serious objection to this report's thesis: that “Transport Energy Infrastructure” may be a category invented for analytical convenience rather than one investors actually need. The clearest answer to that objection is that institutional capital is already underwriting exactly these assets - individually, and increasingly at scale. In May 2025, IONITY secured **€600 million** in financing from nine commercial banks - the largest financing in the history of Europe's charging industry - with €450 million as committed green loan facilities rather than equity.

Central and Eastern European operator GreenWay raised **€138 million** in green debt in 2026, blending EBRD and InvestEU-backed concessional financing with commercial bank participation, on top of capital already raised from infrastructure funds Generation Capital, Helios Energy Investments and Mirova. Portuguese-rooted operator Powerdot raised **€165 million** in green debt alongside a separate €100 million equity round led by Antin Infrastructure Partners, a major European infrastructure private equity firm. UK operator Believ secured **£300 million** from Liberty Global, Zouk Capital and commercial banks. Pension funds including PGGM and APG, and infrastructure managers including Infracapital and GIP, are already counted among the institutional backers of European charge point operators more broadly.
What is notable across these deals is not only their scale but their composition: a shift from equity-heavy financing toward conventional infrastructure debt, as lenders conclude that network-wide utilisation revenue is now predictable enough to underwrite directly. This is the practical, market-tested version of the core-plus characterisation this report applied to the base delivery layer of TEI in Chapter 7 - investors are already pricing it that way, even without a shared label for the category.

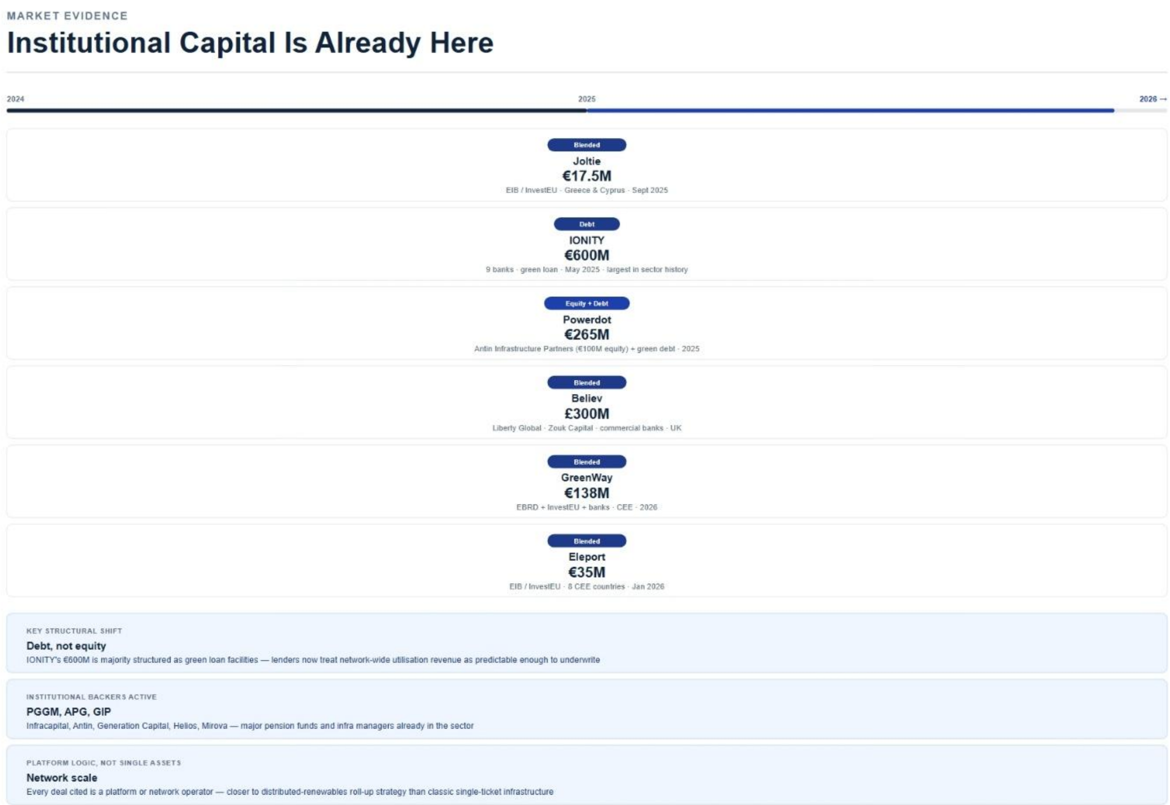

Exhibit 11.1 — Sources: IONITY press release (May 2025); EVBoosters CPO financing roundup (July 2025); GreenWay press release (2026); FLEXeCHARGE CPO funding roundups 2025–2026; EIB press releases (Joltie Sept 2025, Eleport Jan 2026). Deal terms reflect publicly disclosed information only.

The implication for this report's claim is therefore a modest one, consistent with Chapter 10's caution: the case here is not that investors should create a new dedicated allocation bucket called “TEI.” It is that the characteristics set out in Chapter 5 are a useful due-diligence lens for the charging, depot and port-electrification deals institutional investors are already evaluating individually.

11.2 A Due-Diligence Lens Built on Four Characteristics

Chapter 5's four characteristics translate directly into questions a due-diligence team can ask of any specific TEI-type asset:

- Cross-domain integration - Which regulatory regimes govern this asset simultaneously (transport, energy-market, data), and could a requirement introduced under one regime (such as the AFIR ISO 15118 / vehicle-to-grid mandate discussed in Chapter 5) change the asset's cost base or revenue assumptions before the investment thesis has played out?
- Demand-anchored siting - Is the site's revenue case underpinned by a binding regulatory requirement (AFIR spacing and power targets) or by a speculative traffic or fleet-growth forecast? Chapter 8's finding that only 313 of 937 European HDV charging locations currently meet the AFIR power threshold shows that binding rules do not guarantee timely execution; permitting and grid-connection risk must be assessed location by location.
- Operational resilience - What uptime, dynamic-data and payment-access obligations apply under AFIR, and what redundancy or backup arrangements exist to meet them? These are no longer best-practice service standards; Chapter 5 showed they are binding compliance requirements with direct revenue and penalty implications.
- Active participation - What share of the projected return depends on flexibility or ancillary-service revenue, and how exposed is that revenue to the market-saturation risk flagged in Chapter 4 and Chapter 10? One encouraging system-level data point is worth noting for context: industry estimates suggest vehicle-to-grid capability could offset as much as 25 percent of the EU's roughly €584 billion grid-upgrade need by the early 2030s - but headroom at the system level does not guarantee returns at the level of any single asset, and the two should not be conflated in underwriting.

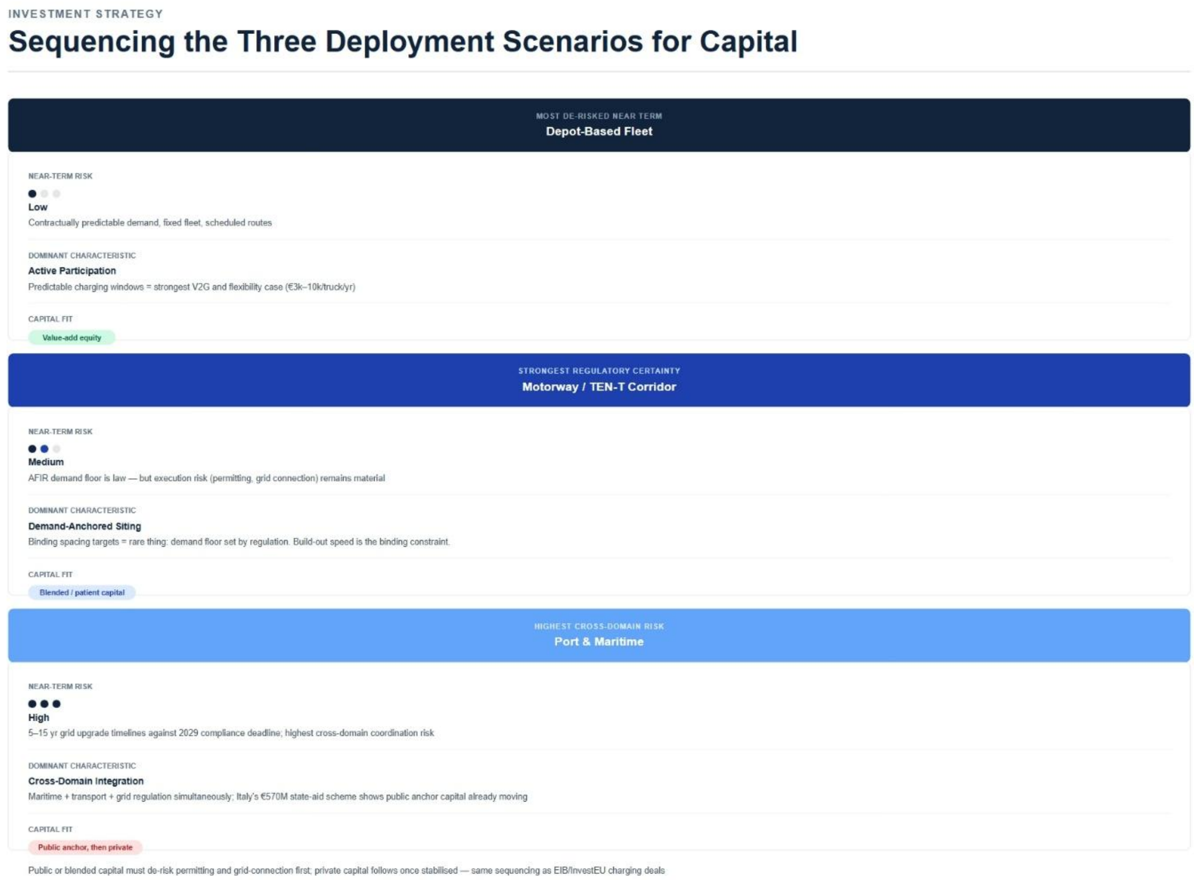

Exhibit 11.2 — Synthesis based on Chapter 11, Section 11.3, drawing on analysis from Chapters 7 and 8. Capital type recommendations are analytical, not investment advice — see Important Notices.

11.3 Sequencing Across the Three Deployment Scenarios

Chapter 8 identified three deployment contexts with different dominant characteristics. They also carry different risk-adjusted entry profiles today:

- Depot-based fleet charging is the most de-risked near-term entry point. Demand is contractually predictable (fixed fleets, scheduled routes), ticket sizes are smaller and more divisible, and the active-participation case from Chapter 4 is strongest here. This is consistent with mid-market and value-add capital, which Chapter 7 showed already targets double-digit returns for assets requiring active management.
- Motorway and TEN-T corridor charging offers the strongest regulatory demand certainty - AFIR's binding spacing targets are a rare thing in infrastructure investing, a demand floor set by law - but Chapter 8's execution data shows this has not translated into proportionate build-out speed. This context is better suited to patient capital structured along the blended lines described in Chapter 7 (EIB/InvestEU-style de-risking of the connection and early-operating phase) than to pure private equity expecting rapid utilisation ramp-up.
- Port and maritime electrification carries the highest cross-domain and permitting risk identified anywhere in this report - grid upgrades of five to fifteen years against a 2029-2030 compliance deadline - but also the clearest near-term policy tailwind, given the binding FuelEU Maritime mandate and precedents such as the European Commission-approved €570 million Italian state-aid scheme described in Chapter 8. This is a context where public or blended anchor capital will likely need to move first, with private capital following once permitting and grid-connection risk has been substantially de-

risked - the same sequencing already visible in the EIB/InvestEU charging deals described in Section 11.1.

11.4 Portfolio Construction: A Platform Logic, Not a Single-Asset Logic

Almost every example cited in this chapter is a platform or network operator — IONITY, GreenWay, Powerdot, Believ, Joltie, Eleport — rather than a single large asset financed once and held. This is structurally different from the classic single-ticket infrastructure investment (one toll road, one airport, one power plant) and closer to the aggregation and roll-up strategies investors have used in digital infrastructure and distributed renewables: many similar, individually modest assets, built and financed in a repeatable pattern, where platform-level scale — not any individual site — is what produces an attractive risk-adjusted return.

This is consistent with the observation already cited in Chapter 7 from Roland Berger's 2026 infrastructure investment outlook, that “hybrid infrastructure assets” not fitting traditional categories are attracting both core-plus and value-add capital because of recurring demand and mission-critical service characteristics, even where individual contracts or sites are smaller and more variable than a classic single-asset ticket. For an investor, the practical conclusion is to apply the layered capital structure proposed in Chapter 7 — senior debt against the base delivery layer, blended capital for early-stage connection risk, value-add equity for the flexibility upside — *at the platform level*, rather than asset by asset.

Note on sources: *Transaction figures in this chapter are drawn from company and lender press releases and industry reporting (EVBoosters, FLEXeCHARGE, IONITY, GreenWay, OneStopESG) current as of the dates indicated; deal structures, investor composition and terms can change after publication, and this report does not independently verify private deal terms beyond what is publicly disclosed. The 25% V2G grid-offset estimate is an industry approximation, not an official EU figure, and should be treated as illustrative.*

Sources to Chapter 11

- IONITY, press release: “IONITY secures record financing to expand critical infrastructure for Europe's electric future”, May 2025.
- EVBoosters, “Inside Europe's biggest EV Charging financing deals (2022–2025): How institutional investors power CPO growth with billions”, July 2025.
- GreenWay, press release: “GreenWay Secures Historic Green Debt Financing up to €138 Million to Continue Leading EV Charging Expansion”, 2026; OneStopESG coverage of the same transaction.
- FLEXeCHARGE, CPO funding and network expansion roundups, 2025–2026 (Powerdot, Believ, Pod Point, and related transactions).
- Eleport, “The 8 Most Important EV Charging Trends 2025” (V2G grid-offset estimate; Milence AFIF financing).
- European Investment Bank, press releases on Joltie and Eleport financings (as cited in Chapter 7).
- Roland Berger, “Infrastructure Investment Outlook 2026” (as cited in Chapter 7).

Chapter 12 - Outlook

12.1 The Argument, in Brief

This report opened with an observation that is, by the standards of the past decade, a genuine success: Europe is decarbonising electricity generation faster than official targets once assumed possible. It closes with a more demanding one. That success has changed, rather than solved, the central strategic problem. The binding constraint on Europe's energy transition has moved from how much clean power can be produced to whether that power — and the infrastructure built around it — reaches the specific points where transport, industry and logistics actually need it.

Three infrastructure programmes that are conventionally analysed apart — transport networks, electricity grids, and transport-energy delivery — show the same shortfall when read together. The connective layer between generation and demand is, across all three, the part that lags. This report has called that layer Transport Energy Infrastructure, argued that it has identifiable characteristics distinct from either conventional transport or conventional energy infrastructure, shown what it looks like in practice across three deployment contexts that matter to this report's core audiences, and set out what its economics, policy treatment and investment case look like once those characteristics are taken seriously.

It has also, deliberately, not overstated its own case. Chapter 10 set out the strongest objections to this thesis directly, rather than leaving them to be raised only by sceptical readers, and Chapter 11 showed that the practical recommendation following from this analysis is modest: a due-diligence lens for capital already being deployed, not a request to invent a new market from nothing.

12.2 What to Watch Over the Next Two Years

Several near-term developments will indicate whether the argument in this report is being borne out in practice, or whether it needs revision:

- 2026-2027 - AFIR's next phase-in milestones for car and truck charging power and spacing take effect, and the European Grids Package enters formal negotiation between the European Parliament and Council. Whether the cross-sector needs assessment proposed in the package is extended to cover transport-energy delivery, as Chapter 9 recommends, will be one of the clearest early signals of whether EU institutions are converging on the framing this report proposes.
- 2027-2028 - The current wave of institutional debt financing for charge point operators (Chapter 11) will have a multi-year track record to assess. Whether utilisation-based revenue continues to perform as lenders expect - or whether refinancing and default patterns emerge - will materially affect how confidently this asset class can be classified as core-plus rather than higher-risk.
- 2029-2030 - FuelEU Maritime's shore-power mandate and AFIR's full TEN-T coverage targets both come into force. Given the execution gaps already visible in 2025-2026 data (Chapter 8), the gap between binding deadline and delivered infrastructure at this point will be a direct test of whether the permitting and financing measures discussed in Chapter 9 were adopted, and adopted in time.

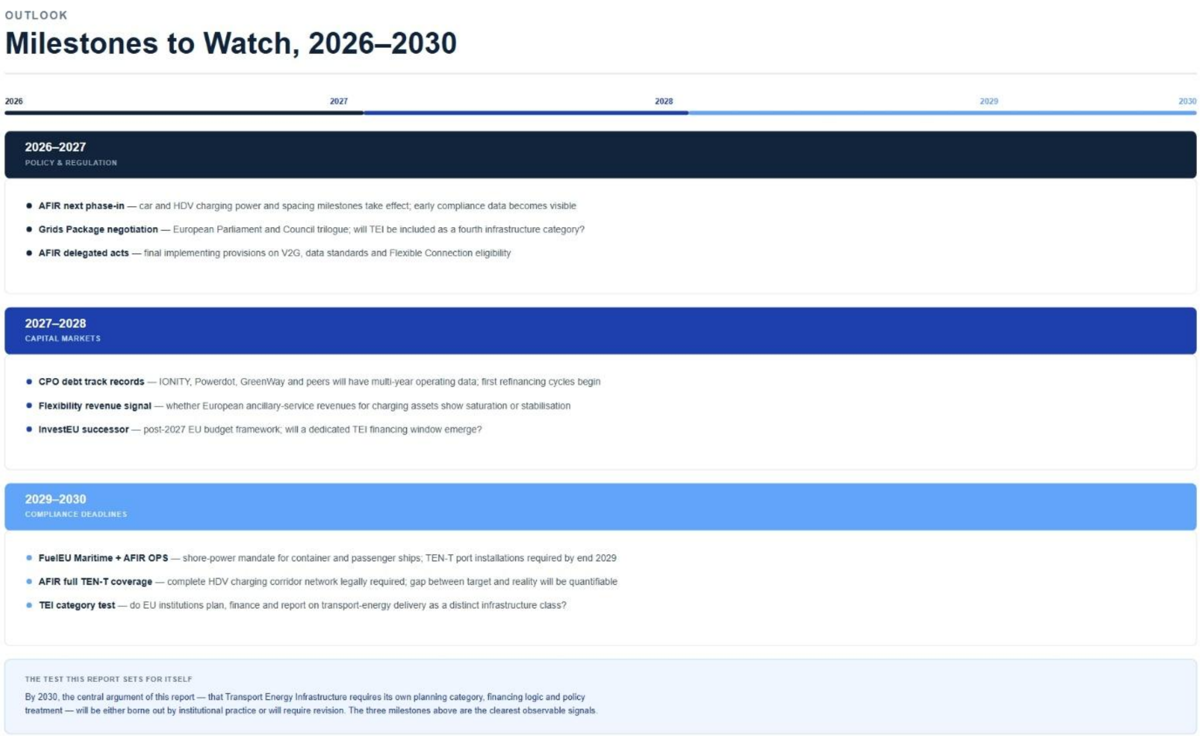

Exhibit 12.1 — Sources: AFIR (Regulation (EU) 2023/1804) phasing schedule; FuelEU Maritime Regulation; European Grids Package (COM(2025) 1005–1007); IEA Global EV Outlook 2026; Chapter 10 (Limitations and Open Questions). Timeline dates reflect regulatory requirements as adopted or proposed at time of writing.

12.3 What This Report Has Not Yet Answered

In keeping with the standard this report has tried to hold itself to throughout, three open items should be stated plainly rather than left implicit:

- A reference architecture. Chapter 6 - examining Modern Mobility's deployment model as one concrete illustration of how the four characteristics in Chapter 5 can be addressed simultaneously in a single asset - remains to be completed, pending verified technical documentation, and will be issued as a completed addition to this report once that material is available.
- Country-level variation. Chapter 10 noted that EU-27 averages can mask wide differences between Member States in regulatory coverage, grid readiness and financing access. A systematic country-by-country assessment was outside the scope of this first report and is a natural candidate for a future paper in this series.
- The post-2030 picture. This report has focused on the period through 2030, where binding regulatory deadlines provide a clear reference point. How Transport Energy Infrastructure evolves once AFIR and FuelEU Maritime's first compliance milestones have passed - and what a second generation of EU infrastructure policy in this space might look like - is a question this report leaves open for future work.

12.4 Closing Statement

The first phase of Europe's energy transition was about proving that clean generation could be built at scale. The data in this report suggests that question is now substantially answered. The next phase will be judged on a different question: not how much clean energy Europe can produce, but how reliably it can be made available — at the depot, at the corridor charging hub, at the quay - to the transport, industrial and logistics systems the European economy actually runs on. Treating that connective layer as infrastructure in its own right, with its own characteristics, its own economics and its own policy treatment, is the central argument this report has made. Whether it is accepted, contested, or refined, is for the institutions, investors and policymakers this report is addressed to.

Note on this chapter: *This chapter synthesises findings and dates already established and sourced in Chapters 2 through 11; it introduces no new factual claims beyond restating, for orientation, the regulatory milestones (AFIR, FuelEU Maritime, the European Grids Package) referenced throughout the report.*

About the Modern Mobility Institute

The Modern Mobility Institute is an independent research initiative focused on the infrastructure layer between energy systems and transport networks. Established in 2025, the Institute analyses the economic, regulatory and operational conditions under which energy becomes available at the point of mobility demand.

This paper is part of the Institute's working series on Transport Energy Infrastructure. It draws exclusively on public sources and does not present proprietary data or commercial positions. The analysis was conducted independently and has not been commissioned or reviewed by any market participant.

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