The Ultimate Electricity Grid Connection Conundrum: The Case for Hyper-Local Secondary Grid Capacity Markets

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Abstract

Electricity grid connection capacity is increasingly scarce, yet a significant amount of the capacity already allocated is used only intermittently. Connection queues now extend to years in many jurisdictions, while network reinforcement remains slow, costly and controversial [1]. The result is a paradox in which long waiting lists for grid access co-exist with substantial volumes of allocated-but-under-utilized capacity, holding back the electrification on which decarbonisation depends. This paper defines grid connection capacity in the context of generation and demand assets, presents anecdotal evidence on utilisation levels, and identifies some structural inefficiencies of prevailing allocation models. To address these inefficiencies, the paper proposes a secondary market for unused connection capacity, that would allow generators and demand customers to buy, sell or lease their capacity rights on a locational and seasonal/time-of-day basis. Within system-operator-defined "capacity transfer locales" that preserve grid security, such a hyper-local secondary market would improve economic efficiency, raise effective network utilisation, generate locational investment signals, shorten queue backlogs and support electrification targets. The paper concludes that trading unused connection capacity offers a credible reform pathway; by enabling dynamic reallocation, improving price discovery and discouraging speculative hoarding, efficiency can be enhanced whilst deferring costly infrastructure expansion.

Keywords: underutilised grid connection capacity; secondary capacity market; locational pricing; network utilisation; capacity transfer; decarbonisation; electrification.

1. Introduction

Electricity systems are undergoing transformation changes driven by electrification, decentralised renewable generation, battery energy storage (at all scales), rapid data-centre growth, electrified heat and industrial decarbonisation. Within this transition, grid connection capacity — the maximum agreed power that generators and demand sites may export to, or import from, the transmission or distribution network — has become a critical constraint. Across many countries, connection queues for both generation and large demand projects now extend several years, while substantial portions of allocated capacity remain underutilised in practice.

This paper explains what grid connection capacity is in the context of connected generation and demand assets, presents evidence on utilisation levels and the structural inefficiencies of current approaches, and sets out the rationale for creating hyper-local markets to trade unused connection capacity in order to improve the efficiency and economic value of national transmission and distribution networks. The remainder of the paper defines connection capacity and its economic characteristics (Section 2), examines how allocated capacity is actually used (Section 3), diagnoses the structural inefficiencies of present allocation models (Section 4), develops the case for a secondary market and its design (Section 5), considers the policy and regulatory requirements (Section 6) and concludes (Section 7).

2. Defining Grid Connection Capacity

2.1 Technical definition

Grid connection capacity refers to the maximum electrical power (in MW) that a generator can export to, or a demand site can import from, the electricity network at its connection point without breaching thermal, voltage or stability limits [2]. The methodologies applied by transmission and distribution system operators (TSOs and DSOs respectively) differ, but the limits are primarily derived from:

- thermal ratings of lines and transformers;
- voltage stability constraints;
- fault-level limits; and
- system security requirements (for example, N-1 reliability standards).

Connection agreements, made at the outset of the build and commissioning process, specify an agreed capacity — often termed Maximum Export Capacity (MEC) for generators or Maximum Import Capacity (MIC) for demand customers and for storage assets when charging. This capacity reflects both local network capability and broader system constraints, and connection agreements may impose conditions on the permitted level of grid access, including releasing capacity in tranches as enabling reinforcements are delivered.

Importantly, connection capacity is not the same as actual power flow. A generator with 100 MW of export capacity may produce at full output for only a limited number of hours each year, as is typical for wind or solar, while an industrial customer with 50 MW of import capacity may leave that capacity partially or entirely unused at times because demand is seasonal or governed by working-day production planning.

2.2 Economic characteristics

Connection capacity exhibits the properties of a scarce, location-specific economic resource. It is geographically constrained and long-lived once granted; it is expensive to procure and difficult — sometimes prohibitively so — to increase; it can be reserved years ahead of use, because capacity is granted before a generator or demand site is commissioned; and, under current arrangements, there is no intrinsic value to the holder in relinquishing capacity that is left unused.

Traditionally, capacity has been allocated on a “first-come, first-served” basis, with applicants securing grid-access rights once they meet regulatory and financial requirements. This administrative mechanism does not, however, ensure that scarce connections are used efficiently or that the relative economic value of competing uses is recognised. Indeed, there is no incentive to relinquish unused capacity and growing connection queues could even represent an incentive to hoard unused capacity with no intention to utilise it. There are growing instances of connection queues being reprioritised — the UK “Connections Reform” process is one example [3] — but these reforms reorder the queue rather than reallocate capacity that has already been granted.

3. Utilisation of Allocated Capacity

3.1 Generation

Generation assets, and renewable installations in particular, typically achieve low average utilisation of their maximum export capacity because of intermittency. Wind capacity factors typically range between 20% and 40% (onshore) and up to 50% (offshore) [4], solar photovoltaic capacity factors between roughly 10% and 25% depending on geography, and even thermal plants may run at declining load factors in systems with high renewable penetration. A 100 MW solar plant might therefore export close to 100 MW during peak sunlight but average nearer 15–25 MW across the year. From the grid’s perspective the full export capacity must

nonetheless be reserved for peak production, even though it remains unused for most of the time. Curtailment during system constraints reduces effective utilisation further: in systems with rapid renewable build-out, generators are frequently constrained off despite holding firm export rights, reflecting the mismatch between network design and production patterns.

3.2 Demand

Large demand customers similarly typically under-utilise their allocated import capacity. Industrial facilities often size import capacity for peak operational demand that occurs only rarely; commercial buildings may hold capacity for worst-case heating or cooling loads; and data centres frequently contract significant capacity in anticipation of future expansion phases. Load factors — average demand divided by peak capacity — for industrial and commercial users commonly fall in the 40–70% range, with some sites considerably lower depending on operational cycles. Electrification intensifies this dynamic: electric-vehicle charging infrastructure is designed around peak coincidence events, electrified heating such as heat pumps creates pronounced seasonal peaks, and hydrogen electrolysers, though capable of flexible operation, often secure firm capacity in any case. Across both supply and demand, then, connection capacity is routinely reserved for infrequent peaks rather than used to its full extent, and current arrangements do not readily allow new electrified load to connect without unnecessary barriers and delay.

3.3 Queue backlogs and idle allocations

Many national grid operators and industry parties report connection queues far in excess of near-term system needs [5][6]. In many jurisdictions, the total generation capacity in the queue exceeds forecast demand growth, with industry analyses pointing to well over 1,000 GW of renewable capacity awaiting connection across Europe. A significant proportion of queued projects never reach construction, yet their reserved capacity blocks access for others. Regulatory reviews in multiple countries have identified projects holding capacity without financial close, developers reserving capacity speculatively, lead times of five to ten years for new grid access, and industrial demand projects delayed by local capacity constraints. This combination of idle reservations and long queues indicates that connection capacity is not being dynamically allocated to active users.

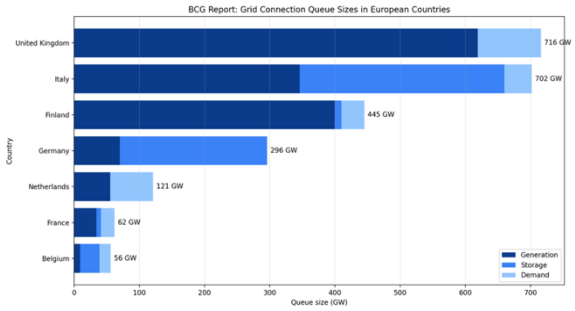


Figure 1: Grid Connection Request Queues across Europe[5].

3.4 Locational visibility

The volume of available connection capacity is attracting greater attention as TSOs and DSOs seek to maximise utilisation of the existing grid alongside continued reinforcement, which remains challenging both economically and in terms of local planning. Many operators now publish available capacity in order to steer new connections toward locations where the grid can accommodate them, thereby improving utilisation and easing congestion. The Elia Grid Hosting Capacity Map (Figure 2) is one such example [7]. Valuable as these initiatives are, they reveal only where new capacity is available; they do not recognise already-granted capacity on the basis of an hourly (or

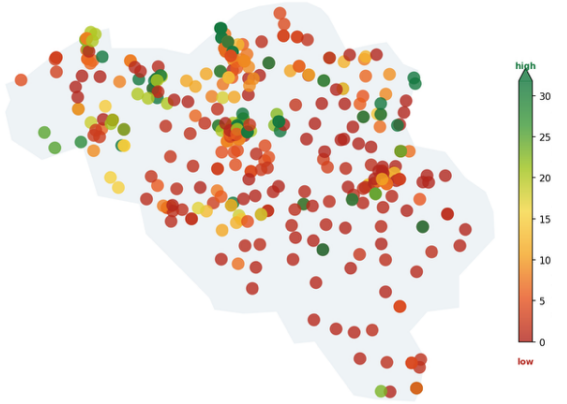


Figure 2: Elia Grid Hosting Capacity Map, showing available grid injection capacity for production by location, based on data published by Elia. [9]. Color code: red = little free capacity green = much free capacity Data source: Elia Hosting Capacity (Prod_0%_flex)

comparable) load profile that is unused, where the maximum is potentially only reached few times per year and could be made available to others without altering the basis on which the original import or export capacity was granted.

4. Structural Inefficiencies in Current Allocation Models

The predominant allocation framework — firm, long-term, location-specific access granted in chronological order — gives rise to several mutually reinforcing inefficiencies, summarised in Table 1.

Inefficiency	Description
Speculative hoarding	Developers and industries secure capacity before project viability is confirmed, reducing turnover and blocking access for ready projects.
Static allocation	Once granted, capacity rights are rarely adjusted even where actual usage is far below agreed levels.
Absent price discovery	Connection charges typically recover infrastructure cost rather than signal locational scarcity, so prices do not guide capacity to its highest-value use.
Temporal mismatch	Capacity, especially granted before introduction of flexible connection agreements, is reserved on a firm, annual basis even though system stress occurs only during limited peak hours.
Underutilised network assets	Grid infrastructure must be sized for a coincident peak that may occur only briefly each year, leaving headroom idle for most of it.

Table 1: Structural inefficiencies of firm, chronologically allocated connection capacity.

Together, these inefficiencies produce artificial scarcity in high-demand locations despite underutilisation of the rights already allocated. This is the “ultimate electricity grid connection conundrum”: where capacity is granted on a maximum-capacity basis, but utilisation tells an entirely different story, and the inevitable consequence is inefficient use of the network.

5. The Case for a Market in Unused Connection Capacity

The conundrum can only be resolved by releasing granted-but-unused capacity, yet at present there is no mechanism for remunerating holders who do so. Recent reforms illustrate the gap. In Germany, the grid package presented in early 2026 moves from “first-come, first-served” to a maturity-based allocation procedure (the Reifegradverfahren) and provides for the capacity maintained at a connection to be adjusted toward the highest value actually measured over a multi-year period where capacity has gone unused — in effect recovering idle capacity without compensating the holder, an approach likely to be contested and to create perverse incentives[8]. In Great Britain, National Grid’s Export Capacity Recovery scheme invites distributed-generation customers using less than a defined share of their Maximum Export Capacity to relinquish the surplus but does so on a purely voluntary basis[9]. Neither of these approaches rewards holders for releasing capacity and therefore neither fully mobilises the idle volumes that exist.

A more efficient outcome could be achieved by introducing a secondary market for unused connection capacity, allowing generators and demand customers to buy, sell or lease their capacity rights on a locational basis.

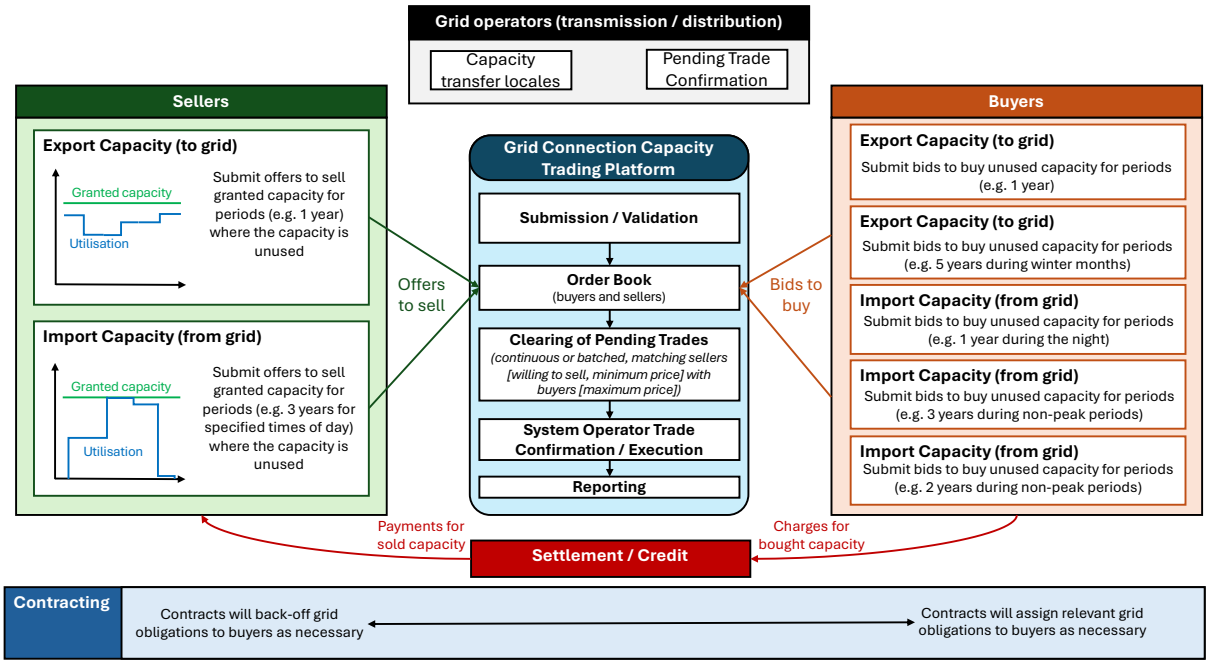


Figure 3: *Overview of the hyper-local secondary grid capacity market concept.*

As the network can accommodate only certain transfers, the proposal gives system operators, at transmission or distribution level, the means to define "capacity transfer locales" — geographic areas within which transfers are permissible from a grid-security perspective. Any transfer of unused capacity would require the buyer to assume all relevant grid connection and access obligations, including those set out in national grid codes, the European network codes and other governing documents [10][11]. This would both substantially improve network efficiency and ensure value flows to the capacity holder; an extension of the principle would allow a share of resale proceeds to accrue to the system operator, funding further grid-efficiency initiatives.

The proposed hyper-local secondary grid capacity market is set out in Figure 3. It provides a market-based mechanism for buying and selling unused capacity, with clearing conditions — time of day, season and minimum contract length — specified and incorporated into the matching of buyers and sellers; buyers would typically require a minimum access period, for example at least one year. To preserve grid security, system operators would define capacity transfer locales delimiting where transfers between locations are permissible, for instance where asset ratings impose limits. The objective is to make these locales as large as the network safely allows, maximising liquidity for capacity trading while ensuring grids can handle the transferred capacity.

5.1 Benefits

Economic efficiency. A tradable capacity system would permit (and more importantly provide the correct incentives for) under-utilising parties to monetise surplus granted capacity, enable new entrants to obtain capacity without waiting for infrastructure upgrades or enduring lengthy connection queues, and allow capacity to flow toward higher value uses. This aligns with basic welfare economics: resources should be allocated to the users with the highest marginal willingness to pay.

Improved network utilisation. Where an industrial user with 50 MW of import capacity consistently draws only 30 MW, the remaining 20 MW could be leased during defined time windows; generators could likewise trade seasonal export rights. Such arrangements would raise effective load factors, reduce curtailment, defer costly reinforcements and enable flexible demand to participate.

Locational investment signals. Market prices for connection capacity would reveal where scarcity is most acute, and therefore where the marginal value of capacity is highest. High local prices would signal the need for grid reinforcement, the value of distributed energy resources, and incentives for flexibly siting new load or generation — information that present arrangements largely obscure.

Reduced queue backlogs. Because holding unused capacity would carry an opportunity cost, a secondary market would discourage speculative reservations and press developers either to proceed to construction or to release capacity, materially shortening queue times for viable projects.

Compatibility with reliability. Capacity trading need not undermine reliability provided that trades are centrally registered and validated by the system operator, technical limits are preserved, and time-of-use or otherwise conditional rights are clearly defined.

Effective use of grid capacity benefits all key stakeholders: end consumers face lower reinforcement costs as existing networks are used more fully; regulators see barriers to entry removed and electrification-led decarbonisation enabled; system operators gain shorter queues, reduced reinforcement pressure and headroom to pursue other beneficial initiatives; existing rights-holders can extract value from unused capacity and access capacity beyond their own connection when electrifying; and new entrants — including emerging technologies such as long-duration energy storage providing balancing and capacity services — can finally obtain the access they need.

6. Policy and Regulatory Considerations

Connection agreements commonly restrict the transfer of connection-capacity rights to third parties without the granting system operator's consent. This is a genuine consideration, but it is workable: consent can be sought either before or after a trade, and post-trade consent has the advantage that the operator knows the location and nature of the recipient. Such an arrangement could be implemented in the short term while the legal status of connection-capacity rights in connection agreements is clarified.

More fully implementing capacity-trading markets would require a clear legal definition of connection rights as transferable property or contractual instruments, transparent registry records, anti-speculation safeguards, coordination between transmission and distribution operators, and mechanisms to preserve non-discriminatory access. Encouragingly, several jurisdictions are already reforming connection processes to prioritise "ready-to-build" projects and to introduce milestone-based retention criteria, signalling growing recognition of allocation inefficiencies and of the need to enable reallocation.

7. Conclusion

Grid connection capacity for generation and demand assets is a technically constrained and economically scarce resource. Although large volumes are formally allocated, utilisation rates for both generators and demand customers frequently sit well below reserved maxima, even as long queues and electrification pressures create the appearance of severe scarcity. This paradox — idle allocations coexisting with access bottlenecks — reflects structural inefficiencies in how connection capacity is allocated.

Establishing secondary markets to trade unused connection capacity offers a promising reform pathway. By enabling dynamic reallocation, improving price discovery, discouraging speculative hoarding and increasing effective network utilisation, such markets could enhance economic efficiency while deferring costly infrastructure expansion. As electricity systems continue to electrify and decarbonise, reforming connection-capacity allocation may prove at least as important as building new physical infrastructure, which is costly, contested and slow to deliver. Making efficient use of existing grid assets is therefore not merely a technical challenge but a market-design and decarbonisation imperative.

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