Understanding Data Centre Flexibility in Europe

Exploring the different forms, opportunities and constraints of data centre flexibility

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A framework for practical discussion

This paper establishes a common understanding of data centre flexibility: what it can mean, where it may create value, and the operational, technical, environmental and economic conditions that shape what is realistically deliverable.

SYSTEM NEED	DELIVERABILITY	VALUE
Start with the grid need and required characteristics.	Assess technical, contractual and operational constraints.	Compare solutions on system value and cost-effectiveness.

Foreword

Over the past year, "data centre flexibility" has become a regular feature of policy and market discussions across Europe. It is often used to mean different things by different people, sometimes in the same conversation. This paper is EUDCA's attempt to fix that: a shared, common understanding of what flexibility actually means in a data centre context, the different forms it can take, and the conditions that determine whether any given form is realistic.

This is not a position paper, and it does not argue for any particular policy measure. It is a reference document, intended to give industry, system operators and policymakers a common vocabulary before the current looseness in terminology hardens into expectations or rules that don't reflect how data centres actually operate.

KEY TAKEAWAYS

DIFFERENT FORMS OF FLEXIBILITY	DIFFERENT DATA CENTRES, DIFFERENT OPTIONS
“Flexibility” is not a single capability or mechanism: It can involve flexible connection arrangements and grid and market integration mechanisms, drawing on different sources of flexibility, including energy assets and, in specific circumstances, workload management. These options differ in feasibility and maturity and should not be treated as interchangeable.	**Not all data centres can offer the same flexibility:** Ownership and operating model (enterprise, hyperscale, colocation, or hosted) influence who controls infrastructure and workloads, and therefore what flexibility may realistically be available.
RESILIENCE ASSETS COME FIRST	**COMPLEMENT, NOT REPLACE**
Backup and resilience assets are not automatically available for grid flexibility: They exist primarily to maintain service continuity, and their use for other purposes depends on technical design, permitting and environmental constraints.	**Flexibility can complement grid reinforcement,** but it cannot replace it. It can improve utilisation of existing capacity and help unlock capacity in the short term, but does not remove the need for continued grid investment and expansion.

1 Introduction

As data centres become increasingly important to Europe's digital economy and electricity system, growing attention is being given to the role they may play in supporting the energy transition. The many facets of this role include driving deployment of clean energy, providing investment in modernizing the grid and reinforcing it against increasing challenges, and on the effects data center demand can have on the grid itself.

In recent years, the concept of "data centre flexibility" has appeared in discussions of the latter issue. Numerous studies, policy discussions and industry initiatives have suggested that if data centres were flexible in their demand, this might reduce the need for more generation or energy infrastructure, and might reduce costs. However, the concept of increasing flexibility to make more efficient use of the energy system is not new, long pre-dating the existence of data centres, and is not particularly related to data centres themselves - the recent drawing of a relationship emerges from the rapid growth and increasing proportion of data centre demand relative to other sources of growth. The term “flexibility” is also often used to describe very different technical concepts, operational approaches and market mechanisms. This can lead to misunderstandings and unrealistic expectations, including in regards to the role data centres can play in supporting the power system.

The purpose of this paper is not to quantify flexibility potential or advocate for specific policy measures. Rather, it seeks to **establish a common understanding of what flexibility means in the context of data centres**, identify the different forms it may take, and highlight the operational, technical, environmental and economic considerations that influence its feasibility.

2 Fundamental principle

Data centres are essential digital infrastructure whose primary function is to provide uninterrupted digital services to society.

Data centres support a wide range of critical societal functions including telecommunications, financial services, healthcare systems, government services, transportation systems, manufacturing operations and digital platforms.

Flexibility solutions, market product, technical requirement, demand-response mechanism or connection arrangement should be assessed against their impact on site power availability. Like virtually all other energy products, both the need for the product and its characteristics should be well-defined from an energy systems perspective, and all market participants should be enabled to compete to provide that product, so that it can be produced in the fashion that makes the most business model, economic, and technical sense for each demand-side participant. If and where IT load can provide those flexibility products, there are additional, unique considerations such as service continuity, resilience obligations and customer service-level agreements (SLAs).

Flexibility is an additional system capability for data centres, which may be able to make varying forms of it available under defined technical, contractual, operational and commercial conditions as well as incentives. It should be developed in a manner that preserves service continuity while enabling data centres and their associated energy assets to contribute to electricity-system needs where feasible.

3 What is data centre flexibility?

Regulation (EU) 2019/943 defines flexibility as "the ability of an electricity system to adjust to the variability of generation and consumption patterns and to grid availability, across relevant market timeframes". The proposed EU data centre rating scheme[1] further refers to "flexibility functions to the grid" as functions provided by a data centre that support grid flexibility, stability, reliability or resilience.

For the purposes of this paper, we would suggest a working definition:

WORKING DEFINITION

Data centre flexibility is the ability of a data centre to interact with the electricity system, in a controlled manner and while maintaining its core service obligations, in response to grid conditions, market signals or contractual arrangements.

Data centre flexibility should therefore be understood as a spectrum of capabilities – potentially relying on multiple sources for load reduction, such as on or off-site energy assets and IT load – rather than a single service or technology. Depending on the characteristics of a facility, flexibility from a data centre itself may be delivered through interactions with the grid, through energy assets located on-site, at production or grid level, or through the management of certain digital workloads.

However, the most economic and useful source of those characteristics may well be from other types of facilities that interact with the grid. Where competitive procurement is feasible, the system need should be met by the resource or combination of resources that provides the required characteristics at the least overall system cost, taking account of technical deliverability and relevant system constraints.

4 Understanding the different types of flexibility

One of the main challenges in current discussions is that the term data centre flexibility is often used to describe very different concepts. In practice, flexibility may depend on the characterization of grid need based on constraint type (generation vs. transmission and spatio-temporal), resources available within or around a data centre, and on the mechanisms through which these resources interact with the electricity system.

4.1 Flexible Connection Agreements

Across Europe, lengthy connection timelines are increasingly becoming a constraint for the deployment of new digital infrastructure. As a result, growing attention is being given to flexible connection arrangements, under which consumers may obtain access to electrical capacity earlier in return for accepting defined operating conditions or flexibility obligations.

Flexible connection arrangements can take different forms depending on the regulatory framework, network conditions and contractual arrangements in a particular Member State. They should therefore be understood as a connection mechanism rather than a specific flexibility service or technology. They should be open to the procurement of the desired flexibility from third parties as well, where those third parties can provide the needed characteristics on a more economic or practicable basis than the data centre itself.

In some cases, flexibility solutions, including energy storage, generation assets or third-party flexibility services, may be used to manage network constraints associated with such arrangements, reducing the need for interruptions to critical operations. This may enable earlier energisation of data centre projects while preserving service continuity and reliability requirements.

Flexible connection agreements are therefore increasingly being considered as one potential tool to facilitate capacity access and improve utilisation of existing network infrastructure while longer-term network reinforcements are being developed.

[1] *European Commission, Commission Delegated Regulation establishing a common Union rating scheme for data centres and its Annexes, 21 September 2026.*

4.2 Grid and market integration mechanisms

Grid and market integration mechanisms refer to the arrangements through which data centres and associated flexibility resources may interact with the electricity system. This may include participation in electricity markets, storage or advanced transmission technology compensation mechanisms, demand-response programmes, congestion-management schemes and ancillary-service markets.

These mechanisms may not create flexibility in themselves, but determine how flexibility available from energy assets or digital workloads can be recognised, procured and utilised by the electricity system markets.

However, existing ancillary-services markets design in Europe vary considerably between Member States and are not necessarily compatible with data centres from an incentive, availability and resource integration perspective. Most of these products were not designed with the characteristics of large industrial loads in mind. The key challenge is therefore not the creation of entirely new technical capabilities, but rather understanding which services are compatible with which data centre operations, identifying appropriate incentives, and ensuring that existing or new flexibility market products are designed in such a way as to recognise the characteristics and constraints of large digital infrastructure as an industrial large load, and allow provision of third-party flexibility when it is more economic or more feasible than flexibility derived directly from data centre operations.

4.3 Flexibility resources and capabilities

Different forms of flexibility may be provided by different resources within or associated with a data centre.

4.3.1 Energy-asset flexibility

Energy-asset flexibility refers to flexibility delivered through dedicated energy infrastructure, such as battery energy storage, thermal storage, advanced transmission technologies, energy management systems, hybrid energy solutions or generation. Some of these resources may also participate in broader distributed energy resource (DER) programmes or virtual power plant (VPP) arrangements, while others may be "front of the meter" solutions.

This category may offer additional flexibility potential but often requires dedicated investments, changes to facility design, additional land, permitting considerations or new infrastructure.

It is also important to distinguish between storage deployed for site-level resilience and storage deployed for wider distribution or bulk power system balancing. For broader renewable integration and system balancing, a significant share of storage needs may sit at production, grid or distribution level, where storage can be aligned with renewable output, wider bulk power system, or distribution system conditions. At data centre level, storage and other energy assets are often more closely linked to resilience, active response and stable interaction with the grid.

The availability of resilience assets, such as UPS systems and backup generation, for flexibility services should not be assumed and depends on their technical design, operational requirements and regulatory constraints, notably strict local permitting, noise or environmental limitations.

The feasibility of these solutions therefore depends not only on technical capability, but also on environmental considerations, down to the very local level, site-specific constraints such as available land and space, the scale of deployment required, the proportionality of the investment and the availability of sufficient incentives or revenue streams to justify deployment.

In some cases, investments in flexibility resources may also create wider system benefits, including improved network utilisation, access to additional capacity or accelerated connection opportunities. The extent to which such benefits are recognised within regulatory frameworks, market arrangements or connection processes may influence the business case for investment.

The effectiveness and value of energy-asset flexibility may also depend on where the relevant resources are deployed. Depending on the system need being addressed, flexibility solutions may be located on-site, dedicated to a specific facility, connected elsewhere on the distribution network, or deployed at a broader system level. The most appropriate solution should therefore be assessed based on the flexibility need, overall system value and the balance of costs and benefits.

4.3.2 Workload flexibility

Workload flexibility refers to the ability to manage, schedule or distribute computing tasks in response to external grid signals or internal data centre operational objectives.

While this concept is increasingly discussed in policy and research debates, its practical availability depends on workload characteristics, service reliability requirements, available capacity, network constraints and the availability of alternative computing resources.

Data centre operators are contractually obligated to provide agreed levels of performance, availability and service quality to their customers. These obligations apply across a wide range of business models and are not limited to traditionally defined mission-critical services. Even if an operator has visibility or control over workloads, customer contracts, service-level agreements, network restrictions such as bandwidth, transport cost and latency, sovereignty and operational commitments frequently limit the extent to which workloads can be shifted, delayed or curtailed by a site operator, given complexities of workload scheduling infrastructure to meet requirements.

For example, workloads supporting critical services, healthcare applications, financial systems or other time-sensitive digital services may not be interruptible or relocatable without affecting customer requirements or service continuity.

As a result, workload flexibility may exist for specific applications or use cases, but should not be assumed to be broadly available across the sector.

The mechanisms and flexibility resources discussed above should not be viewed as equally available sources of flexibility. Grid and market integration mechanisms are generally the most mature and immediately actionable area for collaboration today. Energy-asset flexibility may unlock additional opportunities where supported by appropriate investment and regulatory frameworks. Workload flexibility remains highly dependent on contractual, operational and application-specific constraints and should therefore be assessed cautiously and on a case-by-case basis.

HOW FLEXIBILITY INTERACTS WITH THE SYSTEM	WHERE FLEXIBILITY MAY COME FROM
Flexible connection agreements Connection arrangements that may enable earlier access to electrical capacity in return for defined operating conditions or flexibility obligations. **Grid & market integration mechanisms** Arrangements through which flexibility can be recognised, procured and used — including electricity markets, demand response, congestion management and ancillary services.	**Energy-asset flexibility** Dedicated energy infrastructure such as battery or thermal storage, energy-management systems, hybrid energy solutions or generation. Feasibility can depend on investment, space, permitting, regulation and incentives. **Workload flexibility** Management, scheduling or distribution of computing tasks. Availability depends strongly on workload characteristics, service obligations, network constraints, customer requirements and alternative computing capacity.

5 Not All data centres are the same

Data centres are often discussed as a single asset class. In reality, they encompass a wide range of operating models, workload characteristics and service requirements. As a result, the flexibility potential of a facility cannot be assessed independently of its ownership model, the nature of the workloads it supports, its contractual obligations and its reliability requirements.

The ownership and operating model of a data centre influences who owns the infrastructure, who operates the facility and who is responsible for managing the workloads and services delivered to customers. Different operating models can influence who is able to assess, evaluate and potentially implement flexibility measures, although flexibility potential ultimately depends on a wider set of technical, operational and contractual factors.

Ownership Model	Typical Characteristics	Flexibility Considerations
Enterprise / Self-Owned	The organisation owns and operates both the facility and the workloads it supports	Operational decisions may be more centralised but remain subject to business requirements
Cloud / Hyperscale	Infrastructure and services are owned and operated by a cloud provider	Potentially greater visibility of infrastructure and platform operations, although flexibility remains dependent on workload characteristics, customer requirements and limited direct control over customers' use of workloads.
Colocation	Infrastructure is operated by a data centre provider while customers control their own equipment and workloads	No direct control over customer applications and limited control of operational decisions
Hosted / Managed Services	Infrastructure is managed by a provider on behalf of customers	Flexibility depends on customer commitments, service agreements and business requirements

The type of workload supported by a facility can also influence flexibility potential. Different workloads have different operational characteristics, response-time requirements and tolerance for interruption or delay. However, workload characteristics alone do not determine flexibility potential. Contractual obligations, customer expectations and service-level agreements often impose additional constraints regardless of the underlying technical capability.

While ownership models and workload characteristics can influence flexibility potential, neither should be considered in isolation and neither automatically determines deliverable flexibility. Visibility of, or control over, a workload does not automatically imply an unrestricted ability to modify it in response to power-system needs. In practice, contractual obligations, service-level agreements, reliability requirements and customer expectations frequently determine what flexibility can realistically be delivered. Consequently, conclusions drawn from one ownership model, workload category or use case should not automatically be applied to the wider data centre sector.

6 Conditions for feasible flexibility

Any assessment of flexibility should consider the conditions under which participation is technically, operationally, environmentally and commercially feasible, as well as the flexibility need that is desired – what problem the flexibility is to solve and what are the best flexibility options available to provide that solution, considering the breadth of benefits and the relative cost.

Data centres support a wide range of services that are central to modern society, including cloud computing, telecommunications, financial services, healthcare systems, public administration and digital platforms. As a result, uptime and reliability requirements are often the primary consideration when evaluating flexibility opportunities. Service-level agreements, customer commitments, resilience requirements and business continuity obligations define the **operational boundaries** within which any flexibility solution must operate.

Furthermore, data centres deploy infrastructure primarily to ensure resilience and business continuity. Assets such as UPS systems, backup generation and redundancy mechanisms are designed to maintain service availability during disturbances. Their potential contribution to flexibility should therefore be assessed in the context of their primary resilience function and not assumed to be automatically available for grid-support purposes.

Technical feasibility must also be considered. The ability of a facility to provide flexibility depends on factors such as its electrical architecture, control systems, response-time capabilities, compatibility with existing market products, the availability of on-site energy assets and the characteristics of the network location and system need being addressed. These characteristics can vary significantly between facilities and may influence both the type and extent of flexibility that can realistically be provided.

Environmental and permitting requirements may further constrain flexibility options. Restrictions on backup generator operation, emissions limits, noise requirements and local permitting conditions can all affect the ability of a facility to participate in certain flexibility schemes, particularly where the use of existing resilience assets is contemplated.

Finally, flexibility solutions must be **economically viable** and, from a competitive perspective, the most cost-effective option to meet the suite of needs at issue. In some cases, with respect to flexibility from a data centre itself, participation may require additional equipment, redesign of existing infrastructure or changes to operational practices. The feasibility of such investments will depend on implementation costs, operational complexity, revenue certainty, potential impacts on existing revenue streams or operational performance, and the ability to generate an appropriate return while maintaining the core function of the facility. This must be measured against the costs of alternative solutions that could reasonably provide equivalent solutions to the need in question.

OPERATIONAL	TECHNICAL	ENVIRONMENTAL	COMMERCIAL
Can flexibility be provided while preserving uptime, service-level agreements, customer commitments, resilience and business continuity?	Does the site architecture, control capability, response time, energy infrastructure and network location support the required service?	Do permitting, emissions, noise, land, space and other local constraints allow the relevant assets or operating model to be used?	Is the solution economically viable relative to alternative ways of meeting the same system need, with sufficient incentives and revenue certainty?

7 Common misconceptions

As discussions evolve, several misconceptions frequently appear:

Misconception 1: Data centre electricity demand can be freely adjusted in response to grid needs.

Data centre demand is closely linked to contractual obligations, service-level agreements, customer expectations and operational requirements. The ability to modify demand is constrained by the need to maintain agreed levels of availability, performance and service quality.

Misconception 2: Visibility and/or control over workloads automatically enables workload flexibility.

The ability to observe or manage workloads does not automatically imply an unrestricted ability to delay, move or curtail them. Even where operators have visibility into workloads, contractual obligations, latency requirements, customer expectations and operational commitments may significantly limit flexibility options. Furthermore, some workloads support critical services and may have very limited scope for adjustment. Workload mixes can also change dynamically over time.

Misconception 3: All forms of flexibility are equally available.

Data centre flexibility is not a single capability. It encompasses different mechanisms for interacting with the electricity system and different sources of flexibility, including energy assets and, in specific circumstances, workload management. The feasibility of each depends on the characteristics of the facility, customer requirements, technical architecture, market design and system needs. Consequently, flexibility opportunities should be evaluated individually and not assumed to be universally available or interchangeable.

Misconception 4: Existing resilience assets are automatically available for flexibility services.

Assets such as UPS systems, backup generation and redundancy mechanisms are primarily designed to ensure resilience and business continuity. Their availability for flexibility services depends on technical design, operational requirements, environmental constraints and economic considerations. These assets should not be assumed to be accessible for grid-support purposes.

Misconception 5: Theoretical flexibility potential is equivalent to deliverable flexibility.

Theoretical capability does not translate into deliverable flexibility. Deliverability depends on technical architecture, contractual obligations, reliability requirements, permitting, operational processes and commercial viability. Thus, long-term incentives and alignment on resource integration are critical to ensure data centres can plan infrastructure for flexibility from a power availability and service-level perspective.

Misconception 6: Workload flexibility is equivalent to ancillary-service flexibility.

Different flexibility services operate on different timescales and require different capabilities. While some workloads may theoretically be shifted over hours or days, ancillary-service products frequently require responses measured in seconds or minutes. Compatibility should therefore be assessed on a service-by-service basis rather than assumed. In addition, while flexibility markets continue to evolve, existing ancillary-service products do not always fully capture the value that flexibility can provide in specific locations where the grid is constrained, suggesting there is still scope for further development.

Misconception 7: Flexibility can eliminate the need for grid reinforcement.

Flexibility can complement network planning, improve asset utilisation and help unlock capacity in the short term. It may provide a practical means of accelerating access to electricity capacity while longer-term network upgrades are being planned and delivered. However, flexibility should not be viewed as a permanent substitute for grid reinforcement, transmission expansion and efficient long-term system planning. Europe's grid challenges ultimately require both flexibility solutions and continued investment in network infrastructure.

8 Areas for further assessment

Building on the ongoing work under the Declaration of Intent on the sustainable integration of data centres into the energy system, which brings together data centres, system operators, energy stakeholders and public authorities to explore practical approaches to grid integration, flexibility, planning and infrastructure development, further work should focus on developing a realistic and evidence-based understanding of data centre flexibility, grounded in operational realities and actual system needs:

- Identifying the array of flexibility needs and developing a framework for determining which of those needs are relevant to the issue at hand;
- Identifying the array of flexibility providers - both data centres and third parties - relative to those needs, and determining which providers can offer the most cost-effective solutions, taking account of the immediate need and other benefits or revenue streams;
- Assessing the compatibility of existing and emerging flexibility products with different data centre operating models and system needs;
- Identifying technical, operational and commercial barriers to participation in flexibility services;
- Evaluating technology-neutral incentives and market arrangements that support voluntary participation;
- Assessing the role of dedicated storage and co-located energy assets in facilitating grid integration and access to electrical capacity;
- Exploring the role of flexible connection agreements and other mechanisms that may enable earlier energisation while maintaining operational reliability;
- Assessing how flexibility solutions can complement longer-term grid development and reinforcement;
- Evaluating the contribution of sector-coupling solutions, including thermal storage, waste heat recovery and district heating integration;
- Developing a common understanding of flexibility terminology, metrics and implementation pathways across the digital and energy sectors.

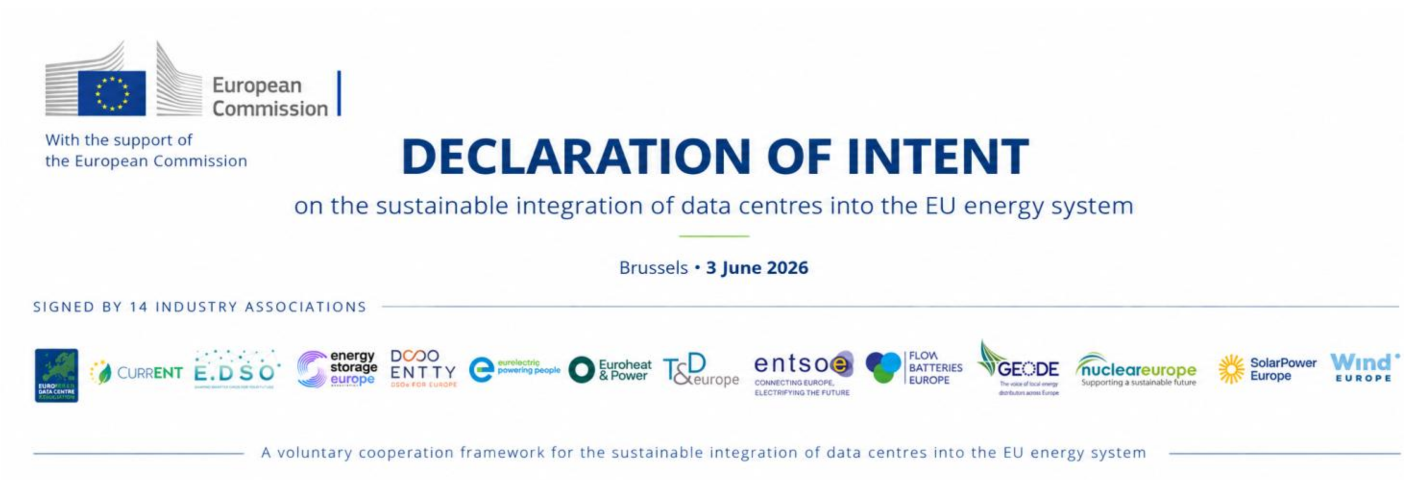

Figure. Declaration of Intent on the sustainable integration of data centres into the EU energy system, signed on 3 June 2026.
Source: European Commission, Flagship projects on AI for grids and data centre sustainability, 4 June 2026.

9 Concluding Remarks

Assessments of flexibility should therefore begin with a clearly defined system need and consider which resource or combination of resources can meet that need most effectively and cost-efficiently.

Data centre flexibility can add real value to the electricity system under the right technical, operational and commercial conditions. Flexibility mechanisms are most effective when they are:

- Voluntary and commercially attractive;
- Supported by clear operational rules, transparent compensation mechanisms and appropriate recognition of delivered system benefits;
- Based on predictable and advance communication of network constraints;
- Applied primarily to new projects that explicitly choose such arrangements;
- Designed in a manner that does not compromise the continuity obligations associated with critical digital infrastructure;
- Clearly identified relative to specific flexibility needs;
- Allowing both data centres and third parties to compete to provide the most cost-effective solutions to meet the desired needs.

Data centre flexibility should be understood as a range of possible complementary interactions between digital infrastructure and the electricity system, and as a part of a wide range of potential providers for those flexibility characteristics. These interactions may occur through grid and market integration mechanisms and may rely on different sources of flexibility, including energy assets and, in some cases, workload management.

The availability, suitability and value of these options with respect to data centres depend on the characteristics of each data centre facility and should not be assumed universally across the data centre sector. Any assessment of flexibility should therefore consider operational requirements, technical feasibility of proven technology solutions, contractual obligations, environmental constraints, economic viability and other site-specific constraints.

Establishing a common understanding of terminology, mechanisms, capabilities and limitations is an important first step towards constructive collaboration between the data centre sector, energy stakeholders and policymakers. Such a shared framework can support more realistic assessments of flexibility opportunities while ensuring that the primary function of data centres, the provision of secure, resilient and highly available digital services, remains fully preserved.