Autorité de la concurrence

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STUDY

Competition issues surrounding the energy and environmental impact of artificial intelligence (AI)

Only the French version is authentic. In the event of any discrepancy,
the French version will prevail over the translation.

Summary[1]

Following the publication of Opinion 24-A-05 on generative artificial intelligence (hereinafter "AI"), the *Autorité* wanted to take its analysis further by examining, in a study, the competition issues surrounding the energy and environmental impact of AI. The rapid development of data centres and AI – which is a key priority for France and the European Union – is driving a sharp rise in electricity consumption and exerting increased pressure on other resources (water, rare metals, land). While improvements in energy efficiency and resource management enabled by AI may partially mitigate these pressures, such effects fall outside the scope of the present study.

Data centres today account for approximately 1.5% of global electricity consumption, but their local impact is far more significant, and their consumption is projected to at least double by 2030 as a result of AI. In France, according to the French electricity transmission system operator (*Réseau de Transport d'Électricité* – RTE), data centre consumption, estimated at 10 TWh in the early 2020s, could reach 12 to 20 TWh in 2030 and 19 to 28 TWh in 2035, representing almost 4% of national electricity consumption. As a result, some major operators – in particular US companies – are securing (or have already secured) supply partnerships for decarbonised energy. At the same time, several digital operators have announced sharp rises in their greenhouse gas emissions, due in particular to the increased energy consumption of data centres and their water consumption amid growing water scarcity.

In the first part of the study, the *Autorité* identifies three types of competition issues on the basis of the above findings.

Firstly, operators face difficulties in accessing the power grid, as well as uncertainties over energy prices, which may affect the sector's competitive dynamics. Public authorities have introduced a number of measures aimed, in particular, at limiting the risk of grid saturation, speeding up the connection of electro-intensive industrial consumers to the power grid, and processing connection requests more efficiently. Furthermore, access to energy at a competitive and predictable price is a major issue in a context where electricity is estimated to account for 30% to 50% of a data centre's operating costs and where, moreover, the energy landscape is characterised by considerable uncertainty. With regard to access and costs, the *Autorité* analyses a number of behaviours likely to raise competition concerns and will ensure that competition is based on the merits of each operator.

[1] The summary is for information purposes only and provides an overview of the following numbered reasons for the study. Only the French version of the study is authentic. In the event of any discrepancy, the French version will prevail over the translation.

In addition, the growing focus on the frugality of AI services is likely to foster the development of new business models, offering certain operators – in particular smaller companies – the opportunity to compete with the biggest operators in the sector. In order to fully play its role as a competitive parameter, however, frugality must not be hindered by operators' behaviour. In the present study, the *Autorité* outlines behaviours that may raise concerns under competition law.

Lastly, the ongoing standardisation of the environmental footprint appears to be a fundamental factor in guaranteeing competition between operators. The *Autorité* identifies several competition issues that may arise in the context of standardisation.

In a second stage, the *Autorité* highlights two key areas of concern. On the one hand, in order to accurately assess the competitive effects associated with the energy and environmental footprints of AI, **reliable and transparent data** is needed to prevent a handful of operators from obtaining a key advantage through access to such information. Such transparency, including through the implementation of standards, would also ensure that frugality can fully play its role as a competitive parameter. On the other hand, **all operators must have access to areas suitable for data centres and to energy, in particular attractively priced nuclear-generated electricity, under conditions that facilitate competition on the merits.**

The *Autorité* invites all stakeholders to take note of this first study on the competition issues surrounding the energy and environmental impact of AI. Moreover, the *Autorité* reminds stakeholders that any suspected anticompetitive practices in the markets concerned can be reported to the *Autorité* and that stakeholders can also seek informal guidance from the General Rapporteur on the compatibility of their projects with sustainability objectives with competition rules.

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INTRODUCTION

1. According to the European Parliament, artificial intelligence (hereinafter "AI") refers to any tool used by a machine *"to display human-like capabilities such as reasoning, learning, planning and creativity*"[2]. Generative AI refers to models capable of generating new content such as text, image, sound or video. Generative AI covers a heterogeneous reality, encompassing both digital infrastructures, consisting essentially of data centres[3], and conversational agents based on foundation models, such as Mistral AI's Le Chat. For a description of the generative AI value chain, see Opinion 24-A-05 on the competitive functioning of the sector (hereinafter "the 2024 opinion")[4] published by the *Autorité de la concurrence* (hereinafter "the *Autorité*") in 2024.

2. Given the central role of data centres and generative AI models, their growth has now become a major strategic challenge. The development of data centres and AI is therefore a key priority not only for Europe, but also for the French government.

3. While the number of jobs linked to the data centre industry in France is currently relatively low, at around 48,400 in total (including 30,000 direct jobs)[5], the direct value added by data centres, according to one industry trade organisation, was €3.4 billion in 2023, plus a further €1.6 billion in indirect and induced benefits (in the construction sector, for example), which support all sectors of the French economy[6], not to mention the national and international visibility of the regions concerned.

4. This priority is reflected in several high-profile public announcements and measures, including:

   - the launch, in 2018, of a national AI strategy aimed at strengthening France's research capabilities and promoting the deployment of AI technologies throughout the economy. A second phase (2022-2025), for which €1 billion has been earmarked under the "France 2030" plan, primarily targets support for the development of innovation in certain priority areas, such as frugal AI (see paragraphs 83 *et seq.* below)[7]. In addition, since the announcement of €109 billion in investments in France at the AI Action Summit in February 2025, 28 new sites suitable for hosting data centres have been identified, in addition to the 35 previously announced sites;

   - the draft law to simplify economic life, currently before the French parliament, also aims to expedite administrative procedures for data centres by classifying them as projects of major national interest. In particular, this classification would facilitate the connection of large-scale data centres to electricity transmission networks;

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[2] https://www.europarl.europa.eu/topics/en/article/20200827STO85804/what-is-artificial-intelligence-and-how-is-it-used (accessed on 2 December 2025).

[3] According to Article 15 of the draft law to simplify economic life tabled on 18 June 2025, a data centre is defined as "*a facility or group of facilities used to host, connect and operate computer systems and servers and related equipment for storage, data processing, data distribution and directly connected activities*".

[4] *Autorité de la concurrence* Opinion 24-A-05 of 28 June 2024 on the competitive functioning of the generative artificial intelligence sector.

[5] France Datacenter & EY study, 2024, p. 7 (French only).

[6] *Ibidem*, p. 8 and 11.

[7] https://www.economie.gouv.fr/actualites/strategie-nationale-intelligence-artificielle (accessed on 2 December 2025) (French only).

- tax incentives, such as the reduced electricity excise duty from which data centres have benefited since 2019[8].

5. Thanks to such initiatives, its surplus of decarbonised electricity based on generation technologies such as nuclear and renewable energy (hydro, wind, solar, etc.), the quality of its network and digital infrastructures[9], and potentially lower electricity prices for electro-intensive operators such as AI operators[10], France is well positioned as an attractive host country for AI-related data centres.

6. Data centres in France have strong growth prospects. Paris is Europe's third-largest city in terms of installed capacity, with 683 megawatts (hereinafter "MW") at the end of 2024, behind Frankfurt (approximately 2,900 MW)[11] and London (approximately 1,000 MW)[12]. The city recorded the second-highest annual growth in both 2023 and 2024. France is estimated to host 322 data centres, ranking third in Europe behind Germany (529) and the United Kingdom (523)[13].

7. However, the development of AI in France comes at a cost, with energy and environmental consequences.

8. The net impact of AI in energy and environmental terms is ambivalent. On the one hand, the development of AI – in particular generative AI – has a major impact on the energy sector and on society more broadly, given its environmental footprint. On the other hand, AI offers opportunities to optimise energy consumption and for innovation in many sectors, such as transport, energy, water treatment, agriculture and climate modelling. This study focuses on the first aspect and, within that, on the competition issues surrounding the energy and environmental impact of generative AI[14]; it does not seek to comment on its net impact.

9. While the competition risks of AI have already been identified, as evidenced by the 2024 opinion, the competition issues surrounding its energy needs and environmental impact, in particular, have received little attention to date, despite becoming major concerns for the sector. One reason for this is the lack of transparency in this area, as the available data is patchy, difficult to compare and even contradictory[15].

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[8] Article 266 (d) C of the French Customs Code (*Code des douanes*).

[9] EY/France Datacenter, Baromètre 2025 – Étude d'impact économique, social et environnemental de la filière des datacenters en France (*2025 Barometer – Study of the economic, social and environmental impacts of the datacenter sector in France*), 11 June 2025, p. 15 *et seq.* (French only).

[10] In its half-year report published in July 2025, RTE reported that French prices – including those on forward markets – are the lowest in Europe (except for Spain) and that prices on forward markets are following a downward trend (see RTE, Bilan du premier semestre 2025 et perspectives sur la sécurité d'approvisionnement en électricité pour l'été [*First-half 2025 report and outlook on electricity supply security for the summer*], 23 July 2025, p. 3, 16 *et seq.*) (French only).

[11] Federal Ministry for Economic Affairs and Climate Action, Status and development of the German data centre landscape – Executive Summary, March 2025, p. 4.

[12] House of Commons Library, Data centres: planning policy, sustainability, and resilience, 3 November 2025, p. 16.

[13] According to the Cloudscene website (accessed on 1 October 2025). The site does not provide a definition of "data centre". However, this order of magnitude is confirmed by other industry operators.

[14] Among sustainability considerations, only environmental considerations are addressed. However, the proposed analysis of competition issues applies, *mutatis mutandis*, to all sustainability considerations.

[15] On the AI "information fog", see, in particular, Sopra Steria, AI & the environment: clearing the information fog, June 2025.

10. After a general overview of the current state of knowledge on the energy and environmental impact of AI **(I)**, this study examines the main associated competition issues **(II)**.

I. The energy and environmental impact of AI

11. AI requires computing power, enabled by the use of advanced graphics processors. These devices are usually hosted in data centres, which are the physical infrastructure underpinning the operation of AI. Accordingly, this study focuses on the energy and environmental impacts associated with data centre operations, while acknowledging that such facilities are not used exclusively for AI and that the overall impact of AI cannot be attributed solely to data centres.

12. The following sections examine, in turn, the energy impact **(A)** and the environmental impact **(B)** of AI.

A. THE ENERGY IMPACT OF AI

13. The rise of AI is driving particularly high energy consumption, due to its substantial electricity needs, notably to power data centres and high-performance computing infrastructure, leading some AI operators to establish new partnerships with operators in the energy sector **(1)**. At the same time, a regulatory framework is being developed to encourage energy efficiency **(2)**.

1. THE GROWING ELECTRICITY NEEDS OF DATA CENTRES AND THE RESPONSE OF ENERGY OPERATORS

a) Substantial electricity needs, amplified by the rise of AI

14. The rapid growth of generative AI is driving an unprecedented wave of data centre construction, with the doubling of production capacity in North America between 2023 and 2024 (i.e. 6.4 gigawatts [hereinafter "GW"] under construction in 2024)[16] and a 21% increase in operational capacity in Europe, with 2.6 GW currently under construction and 11.5 GW in planning[17].

15. The centres require specific infrastructure arrangements.

16. Firstly, the construction of data centres requires the identification of sites that can meet all necessary safety and connectivity requirements (including an assessment of local seismicity and the quality of road and optical infrastructure), obtaining the necessary administrative authorisations (building permits, environmental assessments, etc.) and ensuring the availability of a suitably qualified local workforce. Secondly, proximity to a fibre node, which enables high-speed connectivity, is a critical factor. Such proximity reduces latency (i.e. the response time to queries addressed to AI models) and lowers connection costs, but

[16] By way of comparison, 1 GW is equivalent to the power of a large nuclear reactor. For example, the Flamanville EPR has a 1.6 GW reactor (see, for example: https://reglementation-controle.asnr.fr/espace-professionnels/installations-nucleaires/centrales-nucleaires [French only]).

[17] Allianz, Big beautiful data centers: How AI and infrastructure are giving a second wind to an ailing construction sector, 7 October 2025, p. 9.

also results in a concentration of data centres around the same local loops. Lastly, once built, data centres must be equipped with servers, storage systems and network connectivity.

17. The energy consumption of data centres is also a key consideration.

18. This primarily arises from the electricity required to operate IT equipment, in particular servers (which must run continuously to ensure constant availability) and cooling systems (which are essential for maintaining servers at optimal operating temperatures). In addition, energy is consumed through power supply losses in electrical equipment, the maintenance of backup power systems in optimal condition (generators, batteries, etc.), and the operation of office areas (heating, lighting, security systems, etc.)[18].

19. Energy consumption is particularly significant in the development of AI models, which are hosted in these data centres. According to a report published by the International Energy Agency (hereinafter "the IEA") in April 2025 (hereinafter "the IEA report"), while a conventional data centre may have a capacity of 10 to 25 MW, an AI-focused data centre can exceed 100 MW[19] (consuming as much electricity per year as 100,000 homes, according to the IEA). The elevated consumption of AI-focused data centres is attributable to optimised architectures, notably incorporating specialised graphics processors such as GPUs[20] or other AI accelerators. Each stage in the development of an AI model[21] requires distinct but highly energy-intensive computing resources, in particular during inference when models are publicly accessible (like ChatGPT or Le Chat). Some studies estimate that inference accounts for between 80% and 90% of the computing power used by AI[22].

20. According to the IEA report, data centres – across all uses – currently account for a small share of global electricity consumption (approximately 1.5%, or 415 terawatt-hours [hereinafter "TWh"], in 2024). According to the IEA's Energy and AI Observatory[23], electricity consumption by data centres represented 4.4% of total electricity demand in the United States in 2024, 2.3% in the European Union, 1.5% in Japan and 1.1% in China. However, their local impact is far more significant[24]. Almost half of total data centre capacity

[18] ARCEP, Enquête annuelle – Pour un numérique soutenable (*Annual survey – Towards sustainable digital technology*), 17 April 2025, p. 23 (French only).

[19] International Energy Agency (IEA), Energy and AI, April 2025, p. 38.

[20] A graphics processing unit (GPU) is a processor composed of numerous specialised cores, enabling image computation functions. It is generally found on graphics cards (definition taken from *Autorité* Opinion 23-A-08 of 29 June 2023 on competition in the cloud sector).

[21] According to above-cited Opinion 23-A-08, there are two key phases in the development of foundation models. The purpose of the training phase is to teach the model the general capabilities required to produce the content (text, images or other) that is the most likely answer to a given question. It may be followed by fine-tuning, during which the model is adapted to a specific task. Lastly, the production of content from the trained model, also known as "inference", involves making the model available to end users.

[22] MIT Technology Review, We did the math on AI's energy footprint. Here's the story you haven't heard, 20 May 2025.

[23] IEA, Energy and AI Observatory, 16 June 2025 (accessed on 2 December 2025).

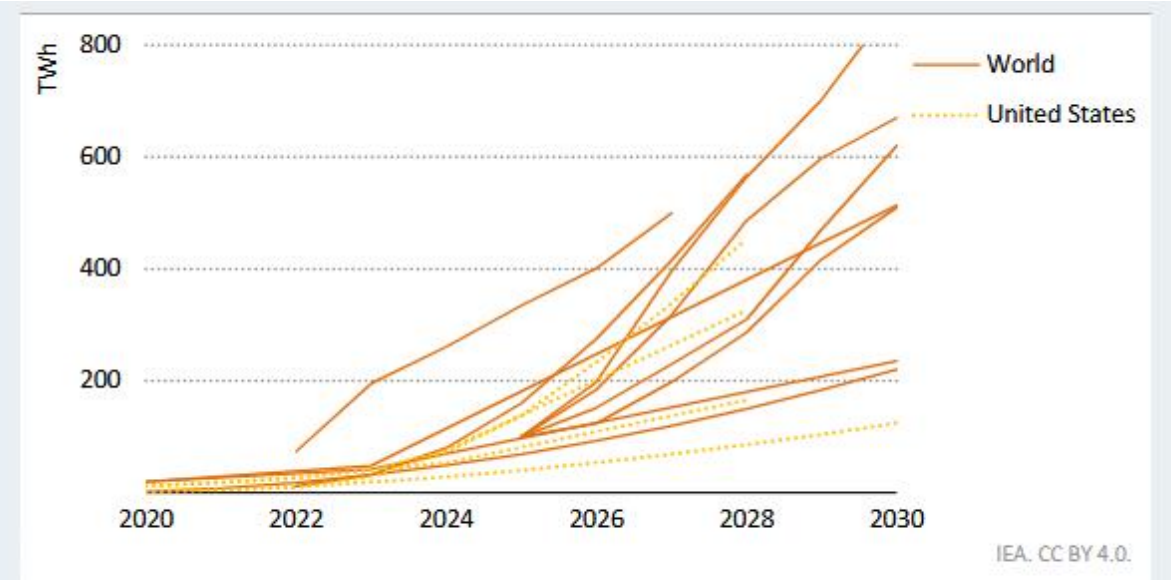
[24] See T. Spencer and S. Singh, "What the data centre and AI boom could mean for the energy sector", commentary published on the IEA website, 18 October 2024: "*when considered in a broader context of total electricity consumption growth globally, the contribution of data centres is modest. Global aggregate electricity demand grows by 6,750 terawatt-hours (TWh) by 2030 in our Stated Policies Scenario, equivalent to more than the combined demand from the United States and European Union today. While growing digitalisation, including the rise of AI, is one factor, continued economic growth, electric vehicles, air conditioners and the rising importance of electricity-intensive manufacturing are all bigger drivers. In large*

in the United States is concentrated in five regional clusters[25]. Furthermore, electricity consumption by data centres is projected to at least double by 2030 (reaching 945 TWh), driven in particular by AI-related demand.

21. Assessing AI-related electricity consumption in data centres can be complex. Operators do not always have visibility over the share of electricity attributable to different workloads, and identifying appropriate measurement criteria is not straightforward. For example, the IEA report[26] proposes basing assessments on the energy consumption of AI servers (also called "accelerated servers"), which account for 24% of electricity demand in data centres, while noting the limitations of this criterion. Specifically, some stages of model inference may be run on conventional servers and, conversely, some non-AI workloads may be run on AI servers.

22. The figure below, presented in the IAE report, shows that estimates of AI's share in total data centre electricity consumption vary considerably across studies. According to the IEA, the estimates are based, at best, on imperfect approximations.

Figure: Estimated data centre electricity demand due to AI, 2020-2030



Source: IEA Report, figure 2.5, p. 57
[The figures are based on data from several external reports: Deloitte (2024), Gartner (2024), Goldman Sachs (2024), Schneider Electric (2024), SemiAnalysis (2024), and Shehabi, et al. (2024)].

23. According to the French electricity transmission system operator (*Réseau de Transport d'Électricité* – RTE)[27], an increase in electricity consumption in France associated with data centres is highly probable. This can be explained by several factors: the rise in demand linked in particular to AI; a potential shift in data centre construction towards France, as certain

economies like the United States, China and the European Union, data centres account for around 2-4% of total electricity consumption today. But because they tend to be spatially concentrated, their local impact can be pronounced".

[25] IEA report, cited above, p. 14.

[26] IEA report, cited above, p. 56 and 57.

[27] RTE, Bilan prévisionnel 2023-2025 – La consommation (*Forecast report 2023–2025 – Consumption*), p. 43 (French only).

countries (such as the Netherlands and Ireland) have chosen to limit their development; and the fact that regulations governing the transfer of personal data outside the European Union – such as the General Data Protection Regulation[28] – promote the establishment of data centres within European territory.

24. Data centre electricity consumption in France, estimated at around 10 TWh in the early 2020s, could reach between 12 and 20 TWh in 2030, depending on the scenario[29], and between 19 and 28 TWh in 2035, representing around 4% of French electricity consumption at that date[30].

b) Agreements between major digital operators and decarbonised energy suppliers

25. Operators in the AI sector, in particular in the United States, rely heavily on fossil fuels to meet their energy needs (gas or coal-fired power plants)[31]; however, they are increasingly turning to decarbonised energy sources, such as nuclear or renewable energy, to stabilise their energy costs and secure the supply to their data centres, in particular in areas experiencing high stress on the power grid[32].

26. Several major digital operators have announced their engagement in renewable energy projects, in particular wind and solar. For example, Microsoft signed an agreement with Brookfield in 2024 for the supply 10.5 GW of green energy capacity in the United States and Europe, a volume eight times greater than the largest power purchase agreement previously concluded by any company[33].

27. In addition to renewable energy, other low-carbon sources – in particular nuclear power – are attracting growing interest. In 2023, Microsoft signed an agreement with Helion to supply its facilities in the United States from a nuclear fusion reactor by 2028[34] and announced the restart of a reactor at an existing nuclear power plant to provide approximately

[28] Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation), OJEU L 119, 4 May 2016, p. 1.

[29] In the above-cited RTE forecast report, three families of scenarios are presented according to consumption trajectories, ranging from the most ambitious (Scenario A) to the least ambitious (Scenario C, developed in a more “adverse” global context), with Scenario B representing partial achievement of the objectives.

[30] RTE Magazine, Transitions, No. 11, December 2024, p. 5 (French only).

[31] Les Échos, Les États-Unis deviennent accros au charbon pour alimenter les centres de données (*The United States is becoming addicted to coal to power data centres*), 30 September 2025 (French only).

[32] For the purposes of this study, no distinction is made between nuclear power and renewable energy. It should, however, be noted that each of these sources has its own advantages and limitations for powering data centres. For example, the intermittent nature of renewable energy generation can pose challenges for infrastructure requiring continuous access to electricity. Initiatives have also been launched to design data centres powered exclusively by renewable energy. Renewable sources already account for a significant share of decarbonised energy in the United States, in a context where nuclear power continues to expand.

[33] Brookfield, Brookfield and Microsoft Collaborating to Deliver Over 10.5 GW of New Renewable Power Capacity Globally, 1 May 2024.

[34] Helion, Helion announces world’s first fusion energy purchase agreement with Microsoft, 10 May 2023.

850 MW of capacity[35]. In 2024, Amazon[36], Google[37] and Oracle[38] declared their support for the development of small modular nuclear reactors, which are less powerful than conventional nuclear reactors[39]. Meta[40] announced the launch of a call for tenders to identify nuclear energy developers capable of supporting AI innovation and, in 2025, signed a 20-year nuclear power purchase agreement[41]. In parallel, Amazon, Google and Meta pledged in 2025 to support a tripling of global nuclear capacity by 2050[42]. Lastly, AI chip maker Nvidia recently announced a significant investment in US start-up Commonwealth Fusion Systems, which specialises in nuclear fusion[43].

28. While most of the agreements are based in the United States, a similar strategy is developing in France, Europe (see below) and the rest of the world[44].

2. A EUROPEAN FRAMEWORK PROMOTING ENERGY EFFICIENCY AND THE USE OF RENEWABLE ENERGY

29. The European Union (hereinafter "the Union") is gradually establishing a regulatory framework aimed at promoting energy efficiency and the use of renewable energy. On a non-exhaustive basis, several initiatives that may have an impact on data centres can be highlighted.

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[35] Constellation, Constellation to Launch Crane Clean Energy Center, Restoring Jobs and Carbon-Free Power to The Grid, 20 September 2024.

[36] Amazon, Amazon signs agreements for innovative nuclear energy projects to address growing energy demands, 16 October 2024.

[37] Google blog, New nuclear clean energy agreement with Kairos Power, 14 October 2024.

[38] https://www.datacenterdynamics.com/en/news/oracle-to-build-nuclear-smr-powered-gigawatt-data-center/ (accessed on 9 December 2025).

[39] According to the French Nuclear Safety Authority (*Autorité de sureté nucléaire* – ASN), small modular reactors (SMR) are primarily intended for the direct supply of energy to industrial customers and are considerably less powerful than conventional reactors (10 to 400 times less than the Flamanville EPR reactor). This significant reduction in output entails, in particular, a new industrial model based on series production, with a large proportion of factory prefabrication, hence the designation "modular" for these small reactors.

[40] Meta, Accelerating the Next Wave of Nuclear to Power AI Innovation, 3 December 2024.

[41] Meta, Meta and Constellation Partner on Clean Energy Project, 3 June 2025.

[42] https://world-nuclear.org/news-and-media/press-statements/major-global-companies-pledge-historic-support-to-triple-nuclear-energy (accessed on 2 December 2025).

[43] Les Échos, Avec Nvidia, l'espoir américain de la fusion nucléaire engrange un nouveau soutien de poids (*With Nvidia, the American hope of nuclear fusion gathers new support*), 31 August 2025 (French only).

[44] In Japan, Google, Microsoft, and Amazon have entered into several agreements with renewable energy producers to power their data centres. In 2021, for example, Amazon concluded an agreement with Mitsubishi Corporation to supply solar energy to power its data centres (see https://www.mitsubishicorp.com/jp/en/news/release/2021/0000047708.html). In addition, some companies, such as cloud gaming specialist Ubitus KK, announced in 2024 their intention to build their data centres near nuclear power plants in Japan (https://www.world-nuclear-news.org/articles/japanese-data-centre-seeks-nuclear-electricity-supplies). In China, Tencent announced in 2024 the launch of a project to use wind and photovoltaic solar energy, combined with on-site battery energy storage, as part of a microgrid solution to power a data centre (https://www.tencent.com/en-us/articles/2202029.html). In 2025, the Chinese company Hailanyun Technology began experimenting with an undersea data centre off the coast of Shanghai, powered 97% by renewable energy sources, in particular offshore wind farms (https://www.solutions-numeriques.com/la-chine-mise-sur-des-centres-de-donnees-sous-marins-pour-refroidir-lia/ [French only]).

30. Firstly, the Energy Efficiency Directive (2012/27/EU)[45] was revised again in 2023 to align with the Union's enhanced environmental and climate objectives. Directive 2023/1791[46] now sets more ambitious targets for reducing energy consumption, including requirements for transparency regarding energy and environmental performance, as well as obligations for the recovery of waste heat from data centres with total rated energy input exceeding 1 MW. Regulation 2024/1364 of 14 March 2024 provides further detail on the reporting requirements[47].

31. Secondly, the Artificial Intelligence Act (Regulation [EU] 2024/1689)[48] promotes the establishment of codes of conduct aimed, in particular, at assessing and minimising the impact of AI systems on the environment. The European Commission (hereinafter "the Commission") will also be required to report at regular intervals on the progress on the development of standardisation deliverables on the energy-efficient development of general-purpose AI models, as well as on the impact and effectiveness of the codes of conduct.

32. Lastly, the Commission has recently published a strategic roadmap for digitalisation and AI in the energy sector, with the specific objective of "*improv*[ing] *data centres' efficiency by introducing a rating scheme (and possibly minimum performance standards); and reduc*[ing] *the strain on electricity grids (e.g. through demand-side flexibility) while minimising the impact for local communities*"[49].

B. THE ENVIRONMENTAL IMPACT OF AI

33. As indicated in the introduction, data on the environmental impact of AI is patchy and, in some cases, contradictory. It also depends to a very large extent on the regions where the inputs required for its operation – such as chips – are produced and where data centres are located. The following sections examine, in turn, the impact of AI on natural resources **(1)** and its carbon footprint **(2)**.

1. Pressure on several resources

34. Beyond energy consumption, AI also mobilises other resources throughout the value chain, the use of which is not environmentally neutral.

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[45] Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, OJEU L 315, 14 November 2012, p. 1.

[46] Directive (EU) 2023/1791 of the European Parliament and of the Council of 13 September 2023 on energy efficiency and amending Regulation (EU) 2023/955 (recast) (OJ L 231 of 20 September 2023, p. 1 to 111).

[47] Commission Delegated Regulation (EU) 2024/1364 of 14 March 2024 on the first phase of the establishment of a common Union rating scheme for data centres (OJ L 1364 of 17 May 2024, p. 1).

[48] Regulation (EU) 2024/1689 of the European Parliament and of the Council of 13 June 2024 laying down harmonised rules on artificial intelligence and amending Regulations (EC) No 300/2008, (EU) No 167/2013, (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1139 and (EU) 2019/2144 and Directives 2014/90/EU, (EU) 2016/797 and (EU) 2020/1828 (Artificial Intelligence Act) (OJ L 2024/1689 of 12 July 2024, p. 1).

[49] https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/14742-Artificial-intelligence-and-digitalisation-for-energy-a-roadmap_en (accessed on 9 December 2025).

35. Water is a prime example. However, in a context of significant and increasing water stress across many regions[50], concerns are beginning to emerge regarding water consumption by AI, as well as water withdrawals[51].

36. Water is an essential input for the entire AI value chain, in particular at the stages of chip manufacturing and the production of construction materials for data centres, both of which require significant quantities of water. However, the most recent available studies focus on direct water withdrawals for data centre operations. Accordingly, the following analysis, which draws on these studies and focuses on data centres, provides only a partial picture of the water withdrawals and consumption associated with AI.

37. Data centres withdraw and consume water for a variety of purposes, including server cooling, air humidification, refilling closed-loop systems, and the cleaning and irrigation of technical equipment. Current technological developments are exerting a dual impact on water withdrawals and consumption. On the one hand, improvements in the performance of chips and AI accelerators are resulting in higher heat output and, consequently, increased water use for cooling. On the other hand, cooling systems are becoming more efficient, thereby limiting water withdrawals.

38. According to the French Regulatory Authority for Electronic Communications, Postal Affairs and Print Media Distribution (*Autorité de régulation des communications électroniques, des postes et de la distribution de la presse* – ARCEP), the volume of water – mainly drinking water – withdrawn by French data centres reached 0.6 million m^3 in 2023. In addition, the annual growth in the volume of water withdrawn in France remains extremely high, at +17% in 2022 and +19% in 2023[52]. Irrespective of any efficiency gains that may be achieved, the increase in water withdrawal volumes is expected to continue in the face of global warming.

39. In addition to direct water consumption, indirect withdrawals and use must also be considered, in particular those associated with the electricity required for data centre operations, which ARCEP estimates at over 5.2 million m^3 per year[53]. Although the volume of water directly withdrawn by data centres is considerably lower than that taken indirectly, it remains a relevant concern for their operations.

40. Economic operators are beginning to recognise the implications of AI for water resources. For example, Mistral AI recently published a study on the impact of the development and use of large foundation models on water consumption, indicating that the training and inference phases account for 91% of this consumption[54]. Similarly, companies such as

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[50] See, for example, French High Commission for Strategy and Planning (*Haut-Commissariat à la stratégie et au plan*), L'eau en 2050 : graves tensions sur les écosystèmes et les usages (*Water in 2050: Serious pressure on ecosystems and usage*), June 2025 (French only).

[51] Withdrawn water is distinguished from consumed water in that consumed water is not returned to aquatic environments after use. For further information, see, for example: https://www.notre-environnement.gouv.fr/actualites/breves/article/prelevee-ou-consommee-comment-compter-sur-l-eau (French only).

[52] See ARCEP survey, above cited, p. 28.

[53] See ARCEP survey, above cited, p. 29.

[54] https://mistral.ai/news/our-contribution-to-a-global-environmental-standard-for-ai (accessed on 9 December 2025).

Microsoft and Google have reported a significant increase (around 30%) in their water consumption in recent years[55].

41. The impact of AI development on water withdrawals and consumption is also beginning to receive sustained attention from public authorities. For example, water input data must now be submitted to ARCEP and incorporated into the European database on data centre efficiency, in accordance with Regulation 2024/1364 of 14 March 2024[56]. In addition, a legislative proposal aimed at promoting the responsible siting of data centres in France – including through the introduction of an incentive-based water levy – was tabled in February 2025[57].

42. Beyond water consumption, AI requires other scarce resources that can have a considerable environmental impact. Computer servers, for example, require large quantities of rare metals[58], which are often extracted intensively using methods that have a major impact on the environment and, more generally, in terms of sustainability. According to a study by the French Economic, Social and Environmental Council (*Conseil économique, social et environnemental*)[59], the quantity of metals required to meet projected demand could increase by a factor of three to ten between now and 2050. In this context, the recyclability and reuse of these resources become highly significant[60].

43. Lastly, it should be noted – although this falls outside the scope of this study – that the rapid expansion of data centres also entails significant risks in terms of land use, which may have implications for biodiversity.

2. A SIGNIFICANT CARBON FOOTPRINT

44. AI has the potential to improve energy efficiency in several sectors. In the transport sector, for example, the aforementioned IEA report[61] indicates that AI could optimise vehicle operation and management, potentially reducing energy consumption by up to 20%. AI could also be used to reduce contrails and improve electric vehicle ranges. Other studies show that AI could improve the management of wastewater aeration, with savings of around

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[55] According to Google's 2025 environmental report, its water consumption increased by 28% between 2023 and 2024 (p. 41). Microsoft's 2024 environmental report indicates an increase in its water consumption of around 34% between 2021 and 2022, and 28% between 2022 and 2023 (p. 26).

[56] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32024R1364. See also ARCEP, Decision 2024-2545 of 21 November 2024 on the introduction of an annual collection of environmental data from electronic communications operators, data centre operators, terminal manufacturers and network equipment manufacturers.

[57] https://www.senat.fr/dossier-legislatif/ppl24-348.html (French only).

[58] According to the French Economic, Social and Environmental Council (*Conseil économique, social et environnemental* – CESE), five raw materials can be considered critical for digital technologies, and therefore also for AI: indium, gallium, tantalum, neodymium and germanium (CESE, Impacts de l'intelligence artificielle : risques et opportunités pour l'environnement [*Impacts of artificial intelligence: Risks and opportunities for the environment*], 24 September 2024, p. 22 [French only]).

[59] *Ibid*., p. 22.

[60] See, for example, French Ministry of Ecological Transition, Biodiversity, Forests, the Sea and Fisheries and INRIA, Document de synthèse sur les principaux défis à relever pour favoriser la performance environnementale de l'IA (English translation available: Position paper on key challenges in fostering the environmental performance of AI).

[61] IEA report, cited above, p. 109 *et seq*.

10%, a reduction in electricity consumption of over 5% and, correspondingly, a 6% decrease in CO_2 emissions from wastewater treatment plants[62].

45. Nevertheless, several studies suggest that AI has a significant net carbon footprint, despite its contribution to energy efficiency[63]. The above-mentioned gains tend to materialise slowly and may, moreover, be offset by the increasing carbon impact of AI itself, caused in particular by the associated sharp rise in electricity demand. Therefore, without a rapid decarbonisation of electricity production, the deployment of AI is likely to exacerbate the overall carbon footprint.

46. Recent statements by several major digital operators seem to point in this direction. While they committed several years ago to achieving at least carbon neutrality by 2030, these objectives now appear difficult to attain given the development of AI[64]. Moreover, carbon neutrality is no longer a priority for the US government. Consequently, some of these same operators have now adopted less ambitious objectives[65].

47. For example, Google announced a 48% increase in its greenhouse gas emissions compared with its 2019 baseline, attributing this primarily to higher energy consumption in data centres and emissions associated with its supply chain. It also recognised the impact of AI on its future emissions: "[a]*s we further integrate AI into our products, reducing emissions may be challenging due to increasing energy demands from the greater intensity of AI compute, and the emissions associated with the expected increases in our technical infrastructure investment*"[66]. Microsoft has similarly reported an increase of around 30% in its carbon emissions for comparable reasons[67].

48. The carbon footprint of AI depends largely on the carbon footprint of the electricity required for its operation, in particular that consumed by data centres.

49. Recent work by a number of public authorities provides a quantified overview of the carbon footprint of the digital sector, and of data centres in particular.

50. In France, a joint study by the French Environment and Energy Management Agency (*Agence de l'environnement et de la maîtrise de l'énergie* – ADEME) and ARCEP, published in January 2025, documents the evolution of the digital sector's carbon footprint,

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[62] Les Échos, Philippe Aghion and Mathias Abitbol, L'AI au service de la transition énergétique (*AI at the service of the energy transition*), 20 November 2025 (French only).

[63] See, in particular, CEPR, Data, power and emissions: the environmental cost of AI, 23 September 2025.

[64] Le Monde, Après Microsoft, Google voit ses émissions de CO_2 bondir à cause de l'AI (*After Microsoft, Google sees its CO_2 emissions surge due to AI*), 2 July 2024 (French only). In addition to Google, whose objective according to the article is to achieve "*net zero emissions by 2030*" (entailing a 50% reduction in emissions compared with 2019 levels and a further 50% offset through investment in carbon sequestration solutions), Microsoft also committed in 2020 to being "carbon negative" by 2030 (see Microsoft, Objectif empreinte carbone négative d'ici 2030 : Microsoft dévoile de nouvelles étapes, dont son engagement dans l'initiative 'Transform to Net Zero' (*Carbon negative by 2030: Microsoft unveils new milestones, including its commitment to the Transform to Net Zero initiative*], 21 July 2020 [French only]).

[65] See, for example, the Fortune article, Google unceremoniously dropped its promise of carbon neutrality, with emissions rising nearly 50% over the last five years, 10 July 2024.

[66] Google Environmental Report 2024, p. 31.

[67] According to Microsoft (2024 Environmental Sustainability Report, p. 5): "[t]*he rise in our Scope 3 emissions primarily comes from the construction of more datacenters and the associated embodied carbon in building materials, as well as hardware components such as semiconductors, servers, and racks*".

despite several significant limitations acknowledged by its authors[68]. The study estimates that the digital sector accounted for 4.4% of France's carbon footprint in 2022, with 50% attributable to end-user devices, 46% to data centres (including equipment linked to data hosting and processing, such as servers, disks, etc.), and 4% to networks.

51. With regard more specifically to data centres, a recent ARCEP survey[69] indicated that, between 2022 and 2023, greenhouse gas emissions from all French data centres surveyed increased by 11%, representing a total of 137,000 tonnes of greenhouse gases.

52. In conclusion, while understanding and analysing the energy and environmental footprints of AI remain complex, the rise of AI is clearly driving substantial energy consumption and giving rise to significant environmental issues, which are likely to evolve in light of its widespread deployment, its very recent emergence, and ongoing developments within the energy and environmental sectors, including those driven by AI itself.

53. Having made these observations, an initial analysis of the competition issues – including those linked to the limited understanding of the energy and environmental impact of AI – can now be undertaken. This is the focus of the second part of this study.

II. Competition issues

54. The energy and environmental impact of AI is likely to raise three main competition issues. Firstly, operators in the sector face difficulties in connecting to the power grid, as well as uncertainties over energy prices, which may affect the sector's competitive dynamics **(A)**. In addition, the growing focus on frugality is likely to foster the development of new business models, offering certain operators – in particular smaller companies – the opportunity to compete with the biggest operators in the sector **(B)**. Lastly, the ongoing standardisation of methods for determining environmental footprints appears to be a fundamental factor in guaranteeing competition between operators **(C)**.

A. ENERGY ACCESS ISSUES

55. In view of the scale of AI operators' energy needs, two types of energy-related issues may affect competitive conditions in the sector: issues relating to access to the power grid, on the one hand, and issues relating to access to energy at a competitive and predictable price, on the other (**1**). While public authorities have introduced a number of measures aimed at facilitating access to energy for AI operators, several competition risks may nonetheless be identified (**2**).

[68] Updated ADEME-ARCEP study, Évaluation de l'impact environnemental du numérique en France (*Assessing the environmental impact of digital technology in France*), January 2025 (French only). It should nevertheless be noted, as the authors themselves point out, that "*the results are conservative, as the assessment also presents certain limitations: no account is taken of telecoms networks outside France, no detailed update of data centres in France is provided, and the development of generative AI is not taken into account*" (p. 3). Moreover, the study acknowledges that it is based on dated data and relies on strong assumptions to estimate the share of uses hosted abroad, which is estimated at 53%.

[69] See ARCEP survey, above cited, p. 19.

1. DIFFICULTIES IN ACCESSING ENERGY AND CONTROLLING COSTS

a) Access to the power grid

56. According to RTE, which was consulted as part of this study, connection requests have increased sharply as a result of the convergence of several factors: the decarbonisation of industry, the deployment of hydrogen-related projects, the expansion of data centres dedicated primarily to colocation cloud computing services and, more recently, the rapid growth of data centres specialised in AI, some of which are exceptional in scale. As regards data centres, RTE reports that connection requests increasingly relate to very substantial capacity requirements.

57. Public authorities have identified a number of difficulties associated with the growing demand:

- a risk of grid saturation, especially in Ile-de-France and Marseille[70], where the concentration of demand, including data centres' connectivity requirements, is very high, thereby creating significant risks of competing uses with industry, households and similar users. The risk is heightened by the fact that data centre operators often organise facilities in clusters in order to ensure redundancy[71] and avoid data loss in the event of a failure. In the short and medium term, managing energy capacity in certain regions that are already under pressure may become a critical issue, notwithstanding the more nuanced assessment provided by RTE in its most recent outlook[72];
- a risk of further lengthening of administrative connection procedures, which are already long and complex and can delay the commissioning of projects by several years. Connection timeframes average between five and seven years, which may impede operators' competitiveness and, indirectly, the attractiveness of France;
- a risk that certain operators may pre-empt sites that are attractive in terms of power[73] or connection capacity, or reserve capacity not immediately utilised due to grid constraints, to the detriment of other projects, including those outside the AI sector.

58. In response, public authorities have introduced a number of reforms that are broadly in line with international recommendations[74].

[70] RTE, Schéma décennal du développement du réseau (*Ten-year network development plan*), 2025 edition, p. 67 (French only).

[71] Redundancy refers to "*the installation of several independent technical resources, whether identical or not, which perform the same function and are intended to replace one another if necessary*" (definition taken from the French terminology database FranceTerme [French only]).

[72] RTE, Résumé exécutif du bilan prévisionnel pour la période 2025-2035 (*Executive summary of the forecast report for 2025-2035*), 9 December 2025, pages 8 and 9 (French only).

[73] Grid connection requires the presence, in the vicinity of the site, of an electrical substation and high-voltage lines (HTB for capacities exceeding 40 MW, or HTA otherwise) (DGE, Guide d'accompagnement – implantation de centre de données [*Guidance document – Data centre siting*), November 2025, p. 11 [French only]).

[74] In particular, the IEA recommends prioritising locations where access to the power grid is easier and the grid is less congested, on the one hand, and encouraging flexibility, on the other, as AI-dedicated data centres often have unused capacity and can optimise their use.

59. Firstly, since 2023, Articles L. 342-2 and L. 342-18 of the French Energy Code (*Code de l'énergie*)[75] have enabled RTE to anticipate future connections to the public electricity transmission network by sizing connection works above the immediate requirements of a given facility, and by allowing RTE to propose the pooling of connection costs under conditions approved by the French Energy Regulatory Commission (*Commission de régulation de l'énergie* – CRE)[76].

60. Secondly, in 2025, the French government introduced an *ad hoc* fast-track procedure to accommodate, on suitable sites, electro-intensive industrial consumers (0.4 to 1 GW) within a reduced timeframe (three to four years), with a guarantee of access to capacity prior to the completion of necessary reinforcement works. The French State can thus reserve capacity on a site suitable for hosting a high-voltage (400 kV) facility, based on three criteria: (1) a land area of several tens of hectares, compatible with the siting of projects of this type; (2) physical proximity to 400 kV transmission infrastructure; and (3) the ability, taking into account upstream grid constraints, to rapidly offer high full-time withdrawal capacity, with dedicated operational measures applied if necessary while awaiting reinforcements.

61. Since May 2025, at the request of the French State, RTE has pre-reserved 3.1 GW at four sites in the Hauts-de-France and Ile-de-France regions, for a period of nine months. Six additional sites have since been announced as potentially suitable for the fast-track procedure, in the Centre Val de Loire, Ile-de-France and Normandy regions.

62. Furthermore, to limit the risk of grid saturation, the French State and local and regional public authorities have begun to encourage the siting of data centres in lower-demand areas, such as Plan de Campagne, north of Marseille, where a new high-voltage substation has been deployed[77]. A similar approach is being applied in the Hauts-de-France region, which hosts 16 of the 65 sites identified by the French State as potentially suitable for hosting data centres in France[78].

63. As noted above, the geographic expansion of data centres, if poorly planned, can exacerbate land pressure and harm to biodiversity. However, when guided by land-use planning

[75] These provisions were introduced by Article 32 of the French law of 10 March 2023 on accelerating the production of renewable energy, JORF 0060 of 11 March 2023 ("APER Law") and by ordinance 2023-816 of 23 August 2023 on the connection to and access of public electricity grids, JORF 0195 of 24 August 2023.

[76] See, in particular, CRE, Deliberation of 7 November 2024 on the approval conditions, content and preparation of requests for the pooling of connections between consumers and distribution network operators to the public transmission network. See also RTE, Schéma décennal de développement du réseau (*Ten-year network development plan*), cited above, p. 50 *et seq*.

[77] RTE explains that, in response to the increasing demand for data centre projects in Marseille, a new substation has been constructed on the outskirts of the city: "*Marseille ranks among the world's top 10 telecom connectivity hubs, owing to its privileged position as the European landing point for numerous international submarine cables. (...) However, the connection conditions in the city impeded the development of the sector's projects: data centres were beginning to compete with other local projects, such as providing electricity to ships at berth in the port, the development of the Euroméditerranée district, and so on. Under the coordination of the regional prefecture, RTE worked with Enedis and the data centre operators to identify a more favourable area for their connection and designed a shared infrastructure to meet demand while optimising network upgrades. The Plan de Campagne area, to the north of the city, will thus host more than 300 MW of projects around a new extra-high voltage substation, with a potential extension envisaged to nearly 500 MW of requested electrical capacity*" (https://assets.rte-france.com/prod/public/2025-01/2025-01-09-transition-numero-11.pdf, p. 5 [French only]).

[78] Le Monde, Data centers : les Hauts-de-France rêvent de devenir la vallée européenne de l'intelligence artificielle (*Data centres: Hauts-de-France dreams of becoming Europe's artificial intelligence valley*), 31 May 2025 (French only).

policies, it can help to reduce infrastructure concentration and strengthen grid resilience, while limiting environmental damage.

64. To some extent, AI also tends to reduce the need to concentrate data centres in the same geographic areas, as illustrated by projects such as Google's data centre in Châteauroux and Microsoft's in Alsace. While the inference phase remains latency-sensitive and therefore requires proximity to urban centres with reliable connectivity, the training phase offers greater flexibility in terms of geographic location[79].

65. Lastly, the significant gap between expressed demand, capacity reservation figures and actual utilised capacity is largely attributable to project abandonments, delays affecting projects, the gradual ramp-up of consumption and the potential existence of predatory strategies by certain operators. In light of this, France has revised its connection rules.

66. Firstly, since 2023, any consumer wanting to reserve capacity must demonstrate control of the land concerned. Secondly, the introduction of Article L. 342-24 into the French Energy Code[80] allows network operators, under conditions defined by the CRE[81], to adjust the connection capacity specified in the network access contract when the maximum capacity actually drawn by the consumer is lower. In the event of gradually increasing demand, the consumer is required to communicate their ramp-up plan, and failure to do so may result in the recovery of capacity. Thirdly, submission of an implementation schedule is required, so that operators can better coordinate their own connection schedules. Fourthly and lastly, a dynamic capacity allocation project, which would allow reserved capacities to be reallocated to the projects completed first rather than according to a first-come, first-served rule, is currently under discussion[82].

b) Access to energy at a competitive and predictable price

67. The second energy-related challenge faced by all stakeholders, including AI operators, is the availability of energy at a competitive and predictable price, which is a particularly critical issue for energy-intensive companies. Data centre operations are particularly energy-intensive, making electricity a major cost factor. According to a study by industry players in France, electricity accounts for 30% to 50% of a data centre's operating costs[83].

68. The European energy context remains highly uncertain. European energy markets have experienced major price fluctuations, in particular following Russia's invasion of Ukraine. In France, the end of the ARENH mechanism, under which electricity suppliers could purchase nuclear-generated electricity from the country's existing power plants at a

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[79] See EY/France Datacenter 2025 Barometer, cited above, p. 13.

[80] This provision stems from ordinance 2023-816 of 23 August 2023, cited above.

[81] See CRE, Deliberation 2024-229 of 18 December 2024 on the conditions for increasing the electrical connection capacity of installations and the associated compensation mechanisms.

[82] See, in particular, RTE, Schéma décennal de développement du réseau (*Ten-year network development plan*), cited above, p. 53; RTE, Schéma décennal de développement du réseau, Consultation publique 2024, document C (*Ten-year network development plan, 2024 public consultation Document C*), p. 27-28.

[83] France Datacenter, Quels atouts pour la France, quels axes d'amélioration ? (*What advantages for France, what areas for improvement?*), 22 October 2024, p. 36 (French only).

regulated price between 1 July 2011 and 31 December 2025[84], has led to the introduction of a dual system:

- the introduction of the redistribution of EDF's profits to end-consumers through a universal nuclear payment (hereinafter "VNU"). The mechanism reduces the electricity price charged by suppliers to end-customers, whether residential or business, while compensating suppliers for any loss of revenue, and is funded by a tax on the use of nuclear fuel for electricity generation (hereinafter "TUCN"), levied on revenues from EDF's nuclear power plants when these exceed a certain threshold; and
- the development by EDF of long-term nuclear production allocation contracts (hereinafter "CAPN").

69. The first component was translated into French law in Article 17 of the 2025 Finance Act (*Loi de finances*)[85]. Unlike ARENH, which was an off-market mechanism that gave EDF's competing suppliers access to part of EDF's historical nuclear output at a regulated price, the new mechanism operates *ex post* and applies to all nuclear electricity generated by EDF's nuclear power plants. It is subject to an opinion by the *Autorité*, to which reference is made here.

70. With regard to the second component, France's historical electricity producer has begun to sign CAPN contracts with major industrial customers. The contracts provide for the allocation of a share of the effective output from the historical nuclear fleet, in return for sharing the associated costs and risks. In early September 2025, data centre operator Data4 signed the first CAPN by an operator in the sector, for the supply of low-carbon electricity to its data centres in France[86]. Under the terms of the contract, Data4 will be allocated a 40 MW share of EDF's operating nuclear capacity for a period of 12 years, in return for sharing the costs and risks based on the volumes actually produced. The first deliveries are scheduled for 2026, for a forecast annual volume of around 230 GWh[87].

71. The end of ARENH and, more generally, the need for energy cost predictability, are also prompting data centres to enter into other direct electricity purchase arrangements (hereinafter "power purchase agreements" or "PPAs")[88], in particular with wind or solar

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[84] The ARENH mechanism was established by French law 2010-1488 of 7 December 2010 on the new organisation of the electricity market, JORF 0284 of 8 December 2010 (the "NOME Law").

[85] French law 2025-127 of 14 February 2025, JORF 0039 of 15 February 2025.

[86] EDF, Data4 signe un accord avec EDF pour l'approvisionnement en électricité bas carbone de ses datacenters en France (*Data4 signs agreement with EDF for the supply of low-carbon electricity to its data centres in France*), 4 September 2025 (French only).

[87] According to estimates in CRE's October 2025 report on the functioning of the French retail electricity and natural gas markets in 2023 and 2024 (p. 18), the average household electricity consumption in 2024 was 4.3 MWh per year. Given that the average household size is 2.2 persons (source: Insee 2021), it can be estimated that: (i) 100 GWh corresponds to the electricity consumption of approximately 23,000 households or 51,000 people (equivalent to the town of Sevran in Seine-Saint-Denis); (ii) 200 GWh corresponds to approximately 47,000 households or 102,000 people (equivalent to the Arras metropolitan area); and (iii) 300 GWh corresponds to approximately 70,000 households or 153,000 people (equivalent to the city of Angers).

[88] According to CRE, "*PPAs are electricity supply contracts between two counterparties, a producer and a buyer, over a given period. The term commonly refers to contracts signed between two counterparties for the production of renewable electricity without any public support, and is limited to cases where the buyer is a consumer or a supplier*" (CRE Report 2025-02, Observatoire de la CRE relatif aux contrats d'achat d'électricité

energy producers. In 2024, data centre operator Equinix and renewable energy producer wpd signed seven PPAs covering seven wind farm projects in France, with an annual production of 300 GWh[89]. Competitor Data4 has also signed two PPAs, with Eurowatt for electricity generated by three wind farms in France, representing an annual volume of 80 GWh, and with Photosol for electricity generated by three photovoltaic farms in France, with an annual production of around 70 GWh[90].

72. However, volumes remain limited compared with other European countries. According to the CRE report, several factors may explain the relatively slow development of PPAs in France. From the buyer's perspective, these include the moderate level of wholesale electricity prices, which remain below the production costs of renewable energy, and France's predominantly decarbonised electricity mix. In addition, a large number of facilities are eligible for public support schemes for renewable energy, making PPAs less attractive to suppliers[91].

2. Competition implications

73. On a non-exhaustive basis, and focusing primarily on operators in the AI and energy sectors, several of their behaviours seem likely to raise competition concerns.

74. The energy constraints discussed above, namely limited supply in the face of potentially very strong demand, can be analysed first and foremost as barriers to entry or expansion, particularly for smaller operators. While measures have been taken by public authorities, or are currently under discussion, notably to facilitate connection to the grid, the *Autorité* encourages all stakeholders to examine the impact of such measures, in order to ensure that, in practice, they enable effective, pro-competitive access for data centres to the French power grid, and to consider the development of complementary solutions, where appropriate.

75. Furthermore, it cannot be ruled out that certain strategies by digital companies aimed at securing energy supplies through agreements with energy suppliers may also have an impact on competition. The main cloud providers – Amazon, Google and Microsoft, which together account for around 58% of the world's hyperscale data centre capacity[92] – have the financial clout to negotiate attractive terms. They can also invest in proprietary storage solutions to strengthen their energy independence. Such advantages may be difficult for smaller operators to match and could further reinforce the privileged position of the largest operators in this fast-growing sector.

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portant sur des actifs de production d'électricité renouvelable (« PPA ») situés en France métropolitaine continentale et recommandations en faveur de leur développement (*CRE Observatory on power purchase agreements for renewable electricity generation assets (PPAs) located in mainland France and recommendations for their development*), March 2025, p. 2 [French only].

[89] Equinix, Equinix et wpd concluent l'un des plus importants contrats d'achat d'électricité verte en France (PPA), finançant la création de sept nouveaux parcs éoliens et la décarbonation du réseau (*Equinix and wpd conclude one of the largest green electricity purchase agreements (PPAs) in France, financing the creation of seven new wind farms and the decarbonisation of the grid*), 31 January 2024 (French only).

[90] Data4, Data4 signe deux « Power Purchase Agreement » (PPA) avec des leaders français de l'énergie renouvelable (English translation available: Data4 signs two Power Purchase Agreements (PPA) with French renewable energy leaders), 21 March 2024.

[91] CRE Report 2025-02, above cited, p. 2.

[92] Allianz study, cited above, p. 10.

76. In the context of tension on the power grid in certain areas, and the pre-identification by public authorities of sites suitable for the application of the *ad hoc* fast-track procedure described above, several operators have expressed concerns regarding a potential strategy whereby the largest operators might reserve electricity capacity beyond their actual needs, thus depriving their competitors of access to the energy required and potentially driving up prices. While public authorities have taken measures to limit this risk of foreclosure, the *Autorité* urges all stakeholders to remain vigilant.

77. With regard to energy suppliers, as the *Autorité* and CRE[93] recently stated, the conclusion of CAPN contracts by EDF must not lead to anticompetitive behaviours, such as discrimination, refusal to supply or foreclosure of the market for large industrial consumers, to the detriment of competitors.

78. The risks of capacity saturation and supply tensions are not entirely new in Europe, as illustrated by the example of Ireland, which has been forced to limit the development of data centres at a time when they account for over 20% of the country's electricity consumption. However, these risks remain hypothetical in France at present, in particular due to the measures implemented to limit over-reservation of capacity and its potential negative effects on the French power grid. Beyond supply concerns, this situation would also automatically result in higher prices for other users, notably households.

79. Lastly, a number of factors suggest that major digital operators could, even if only occasionally, enter energy markets as suppliers, especially abroad. Beyond the agreements concluded in the United States between digital giants and energy suppliers (see above), these operators may also have excess capacity.

80. Data centres are generally equipped with generators to ensure continuity of supply in the event of a power failure, as a substitute for the local energy supplier. Battery energy storage systems may also be used to discharge energy back into the grid when electricity production declines, as demonstrated by the agreement concluded in September 2025 between Shell and Google in the United Kingdom[94]. Once equipped with these capabilities, data centre operators could potentially position themselves in the upstream energy supply market[95].

81. Furthermore, the development of consumption optimisation strategies may enable data centre operators to temporarily reduce their electricity consumption to alleviate grid pressure in exchange for remuneration (so-called demand-response mechanisms), thereby positioning them as fully-fledged participants in the power grid.

82. Consequently, energy access and cost control are not merely technical issues for data centres, but represent factors that may affect competition in both digital and energy markets, with potential implications for consumers. The *Autorité* will ensure that competition is based on the merits of each operator and urges companies in the sector to remain vigilant regarding these issues.

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[93] Press release, The French Energy Regulatory Commission (*Commission de régulation de l'énergie* – CRE) and the Autorité de la concurrence publish their letter to the French government containing proposals to ensure fair competition in the implementation of the electricity market reform, 16 January 2024

[94] Shell, Google selects Shell as its renewable energy manager in the UK, 16 September 2025.

[95] The Shift Project, Intelligence artificielle, données, calcul : quelles infrastructures dans un monde décarboné, Interim report, March 2025, p. 50 (English translation of the Final report available: AI, data, and computing: shaping infrastructures for a decarbonised world).

B. ISSUES SURROUNDING THE EMERGENCE OF FRUGALITY AS A COMPETITIVE PARAMETER

83. In response to the energy and environmental impact of AI, the concept of frugal AI is emerging. A definition is presented below **(1)**, together with its potential competition implications **(2)**.

1. FRUGALITY AS A RESPONSE TO ENERGY AND ENVIRONMENTAL CONSTRAINTS

84. Given the significant resource consumption associated with AI, in particular its energy needs, and the simultaneity of its development with the need to limit the environmental impacts of consumption, as reflected within the Union by the "Green Deal" in particular, the concept of frugal AI has emerged over the past several years.

85. According to the general framework issued by the French Standardisation Association (*Association française de normalisation* – AFNOR), frugality can be defined as follows: "[t]*he aim of a frugal AI service is to reduce the overall need for material and energy resources, and the associated environmental impacts, by redefining usage or performance requirements* (...)*, or by redirecting needs from the producer of the AI system (upstream) to the provider of the service in question. A frugal AI service is therefore a service for which:*

- *the need to use an AI system rather than another less energy-intensive solution to meet the same objective has been demonstrated;*
- *best practices (...) are adopted by the AI producer, provider and customer to reduce the environmental impacts of the service using an AI algorithm;*
- *the uses and needs aim to remain within planetary boundaries and have been previously examined*"[96].

86. While similar to the concept of efficiency, in that it seeks to optimise resource consumption, frugality differs by considering this optimisation in terms of minimising environmental impact, and goes further by encouraging operators to define their AI needs and usages with this objective in mind[97].

87. In practice, during the preparation of this study, stakeholders indicated that the question most frequently raised was whether to favour generalist models or smaller, better-adapted models.

88. Although, initially, the main models appeared to follow a similar trajectory, based on the idea that their performance increased with the number of parameters, the volume of data, computing power and, consequently, resource consumption, several recent examples have shown that it may be possible to develop models that are just as efficient but consume fewer resources, in particular for specific tasks.

89. Studies have shown that, for applications related to medical imaging or computer vision (which enable machines to analyse data from images or videos), small models can deliver high performance while remaining resource-efficient. For text processing, smaller models may also suffice for more targeted tasks such as text embedding, a technique used to convert words into numerical representations that can be understood by a computer, as opposed to text understanding, for which larger language models perform better. The open-source

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[96] Référentiel général pour l'IA frugale (English translation available: General framework for frugal AI), AFNOR SPEC 2414, June 2024, p. 22.

[97] *Ibid.*, p. 21.

approach also facilitates model reuse, thereby enabling the pooling of all or part of the computationally-intensive training phase[98].

90. Carbone 4 reached the same conclusion in its work with Mistral AI on environmental footprint: the lightest models have a reduced impact in proportion to their size, with a factor of 100 difference between Mistral's largest and smallest model, Ministral, which remains effective for simple queries[99].

91. Others argue that the industry's constant innovation in software and infrastructure is contributing to improved environmental performance by generative AI. According to Google, for example, over a recent 12-month period, the energy and total carbon footprint of the median Gemini Apps text prompt dropped by 33x and 44x, respectively, all while delivering higher quality responses[100].

92. It now appears that frugality in AI-based solutions needs to be considered as a competitive parameter[101]. In other words, demand in AI solution markets may place value on the frugality of a solution, just as supply may seek to differentiate itself on this aspect. Several examples illustrate this.

93. On the demand side, the introduction of environmental and energy regulations is likely to bring AI frugality to the fore as a quality criterion and, in some cases, may even lead to the identification of a relevant segment, or potentially a distinct market. Accordingly, the inclusion of environmental clauses in public procurement contracts for AI solutions is likely to emphasise AI frugality as a quality attribute for differentiating offers.

94. Another example is the inclusion, in the France 2030 call for projects "Accelerating the use of generative AI in the economy"[102], of a criterion relating to the environmental impact of AI-based solutions. This criterion notably requires the use of Green Algorithms, a carbon footprint measurement tool, and compliance with the DNSH (Do No Significant Harm) principle, as defined in Article 17 of the Taxonomy Regulation[103]. A similar trend can be

[98] For a theoretical overview, see, for example, G. Varoquaux, A. S. Luccioni and M. Whittaker, Hype, Sustainability, and the Price of the Bigger-is-Better Paradigm in AI, March 2025, cited in Les principaux défis à relever pour favoriser la performance environnementale de l'IA, the position paper prepared by the French Ministry of Ecological Transition and INRIA for the AI Action Summit (English translation available: Key challenges in fostering the environmental performance of AI), February 2025 (p. 4).

[99] Le Monde, Mistral AI parie sur la transparence en rendant public son impact environnemental (*Mistral AI bets on transparency by making its environmental impact public*), 22 July 2025 (French only).

[100] Google Cloud blog, How much energy does Google's AI use? We did the math, 21 August 2025.

[101] On environmental considerations as a competitive parameter, see, for example, Commission Notice on the definition of the relevant market for the purposes of Union competition law, C(2023) 6789 final, 8 February 2024, paragraph 50; *Autorité de la concurrence* Opinion 25-A-01 of January 9, 2025 on rating systems designed to provide consumers with information on the sustainability-related characteristics of consumer products and services, paragraphs 127-138; *Autorité de la concurrence* Informal guidance 24-DD-01 of 14 June 2024 on a standardised methodology for calculating products' environmental footprint in the animal nutrition sector, p. 3.

[102] France 2030 Call for Projects, Accélérer l'usage de l'intelligence artificielle générative dans l'économie (*Accelerating the use of generative artificial intelligence in the economy*), Specifications, April 2024 (French only).

[103] Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment by establishing a classification system (or "Taxonomy") for environmentally sustainable economic activities, OJ L 198 of 22 June 2020, pp. 13-43.

observed across the entire value chain, as evidenced, for example, by the increasing importance of environmental footprint criteria in calls for tenders for data centre projects.

95. With regard to business demand, the *Autorité* has noted that companies are paying increasing attention to frugality. Orange, for example, now encourages its customers to consider and seek advice on the frugality of AI tools[104].

96. On the supply side, there is a growing, but still minority, trend among AI operators to communicate on the frugality of their models or their pursuit of frugality. For example, OpenLLM France[105] now highlights the pursuit of efficiency and sobriety as a key strategic focus. Similarly, several international operators offer smaller models, such as Google's Gemma, Mistral AI's Ministral and Microsoft's Phi ranges.

97. On 22 July 2025, Mistral AI published a study on the environmental impact of its main model, Mistral Large 2, covering both the CO_2 footprint and resource consumption during training and use[106]. It justified the study by its intention to include frugality among competition parameters[107].

98. Furthermore, even when frugality is not explicitly highlighted, several developers of large language models aim to adjust their model's size to the user's request. This is the case, for example, with OpenAI's GPT-5 model. OpenAI explains that its model is based on three components: a smart, efficient model that answers most questions, a deeper reasoning model (GPT-5 thinking) for harder problems, and a real-time router that quickly decides which to use based on conversation type, tool needs and user intent[108].

99. Upstream, some data centre operators also appear to be increasingly focused on measuring and minimising their environmental footprint. Data4 reports, for example, that it conducts life cycle analyses of its facilities, incorporates the results into its deployment strategies and develops solutions to improve the environmental footprint of its data centres[109]. Similarly, OVHCloud provides its customers with a calculator to generate monthly reports on their carbon emissions[110].

2. COMPETITION IMPLICATIONS

100. Since frugality – and carbon impact in particular – can constitute a competitive parameter, companies developing frugal AI tools, as well as data centres seeking to minimise their

[104] Orange, "Frugal AI: maximizing intelligence, minimizing costs and emissions", March 2025.

[105] https://www.openllm-france.fr/ (accessed on 9 December 2025) (French only).

[106] Mistral, Notre contribution pour la création d'un standard environnemental mondial pour l'IA (English translation available: Our contribution to a global environmental standard for AI), 22 July 2025. See also Le Monde, Mistral AI parie sur la transparence en rendant public son impact environnemental (Mistral AI bets on transparency by making its environmental impact public), cited above.

[107] Mistral, Notre contribution pour la création d'un standard environnemental mondial pour l'IA (English translation available: Our contribution to a global environmental standard for AI), cited above.

[108] https://openai.com/index/introducing-gpt-5/ (accessed on 9 December 2025).

[109] Data 4, Les opérateurs de données centers sont les architectes d'un numérique durable (English translation available: The key to a sustainable digital economy is data center operators) 26 June 2025. (accessed on 9 December 2025).

[110] https://help.ovhcloud.com/csm/en-gb-carbon-footprint-calculator?id=kb_article_view&sysparm_article=KB0066743 (accessed 9 December 2025).

environmental impact, can benefit from a competitive advantage[111]. This advantage may, for example, help to stimulate competition, notably through the entry or expansion of smaller operators.

101. Firstly, frugality can affect price. Frugal AI optimises costs based on actual need (i.e. a deliberate pursuit of efficiency), which can make it especially competitive on price. In this respect, frugality aligns with classical notions of efficiency, and frugal AI may consequently confer a competitive advantage on its developer. This pursuit of energy optimisation and a reduced environmental footprint can also occur upstream, notably in data centre operations.

102. Secondly, frugality can affect competition from a quality perspective. A frugal solution may satisfy a customer's need for energy or environmental sobriety, either because it is inherently resource-efficient, or because it has a lighter footprint and can therefore be adapted to smaller-scale deployments, for example by leveraging existing IT infrastructure.

103. Lastly, frugality can affect competition in terms of the incentive and ability to innovate. As a key development focus in the sector, frugality can steer a portion of innovation towards frugal solutions, thereby fostering competition through the diversity of innovations. Moreover, because frugal AI can be less costly and easier to deploy, it can stimulate innovation among operators, particularly new or smaller ones.

104. That said, if frugality is to fully play its role as a competitive parameter, it must not be hindered by operators' behaviour. In this regard, and on a non-exhaustive basis, this study offers an overview of certain behaviours that may raise concerns under competition law, and urges all operators in the sector to be vigilant.

105. Firstly, some operators may be tempted to adopt misleading practices regarding frugality. Such a situation could arise when the frugality or environmental footprint reported is not based on a scientifically robust methodology[112].

106. For example, one or more operators may, individually or collectively, promote the frugality – or, more specifically, the low or limited environmental impact – of their solutions, even where such characteristics are inaccurate. Whether or not the misleading nature of such claims is intentional, they may amount to a form of "greenwashing". Such conduct may therefore raise concerns under competition law (abuse of a dominant position or anticompetitive agreements), either because it may cause direct harm to customers or because it may enable the operators concerned to obtain an undue competitive advantage, such as favourable conditions for operating in a particular market.

107. Accordingly, the *Autorité* calls on public authorities to exercise particular vigilance in the definition and implementation of selection criteria, both in public procurement procedures and in the granting of financial support. In particular, the application of eco-conditionality criteria enabling a data centre to benefit from a reduced rate of excise duty on electricity should be treated as a matter requiring specific attention by public authorities.

108. Secondly, a failure to disclose information on the environmental footprint or, more broadly, the frugality of an AI service or model, even where there is a demand for access to such

[111] See, for example, sharing this analysis, the comments by the President of ADEME in Médiapart, IA : un puits sans fond de dépenses en énergie, en eau et en CO_2 (A*I: A bottomless pit of energy, water and* CO_2 *expenditure*), 10 February 2025 (French only).

[112] See, by way of illustration, Informal Guidance 24-DD-01 of 14 June 2024, cited above, p. 6 and 7; and Opinion 25-A-01 of 9 January 2025, cited above, paragraph 150, where a comparable risk is highlighted.

information, may raise concerns under competition law, if such refusal results from a joint decision by several competing operators or is made by a dominant operator.

109. The fact that a large proportion of operators still do not provide measurements of the environmental footprint of their models[113] raises concerns, even if the commercial sensitivity of the underlying data partly explains the lack of disclosure. A similar issue may arise from a competition law perspective if the refusal occurs upstream, either by a dominant supplier or by several suppliers that have adopted a common position, thereby hindering the ability of data centres or, further downstream, model developers to address the frugality and, in particular, the environmental impact of their services.

110. Lastly, it cannot be ruled out that certain operators, including upstream in the value chain, may adopt behaviours aimed at limiting innovation in frugality. Such behaviours could take the form of unilateral or collusive conduct that hinders the development of innovations addressing the need for frugality. They could also involve acquiring stakes, including minority stakes, in the capital of other operators with the purpose or effect of reducing or eliminating competition on frugality, which could be addressed under merger control or competition law, depending on the nature of the influence exercised[114].

C. ISSUES SURROUNDING THE ONGOING STANDARDISATION OF THE ENVIRONMENTAL FOOTPRINT

111. The environmental footprint of AI is currently the subject of several types of standardisation. The various ongoing initiatives are presented below **(1),** followed by an assessment of the potential competition implications **(2)**.

1. THE EMERGENCE OF AI STANDARDS

112. Given the significance of the environmental impact of AI, and the growing interest in achieving a better understanding of this issue, there is an increasing emphasis on enhancing transparency in this area, in particular to improve comparability.

113. More specifically, this need arises from the convergence of three findings, as indicated by the French Ministry of Ecological Transition in the course of preparing of this study: companies that model or use AI-based solutions provide little information about their environmental impact; there is no shared methodology for operators to communicate on this impact; and the measures taken to date are difficult to compare, especially given the differences in their scope.

114. Different types of tools have been developed to address this need, in particular:

- standardisation, which covers several aspects, from design to communication, and may, in particular, take the form of best practices proposed by public authorities; and
- tools for measuring the environmental footprint of AI itself.

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[113] See, for example, the data presented in a recent article by S. Luccioni, B. Gamazaychikov, T. Alves da Costa and E. Strubell, Misinformation by Omission: The Need for More Environmental Transparency in AI, June 2025. See also, for example, Les Échos, Il y a une opacité organisée par les acteurs de la tech : comment l'impact environnemental de l'IA est passé sous silence, (*There is organised opacity by tech actors: how the environmental impact of AI has been kept in the dark*), 26 June 2025 (French only).

[114] See Opinion 24-A-05 of 28 June 2024, cited above.

115. In terms of standardisation, several tools have recently been or are currently being developed. For example, ARCEP and the French Regulatory Authority for Audiovisual and Digital Communication (*Autorité de régulation de la communication audiovisuelle et numérique* – ARCOM) have co-published a general framework for the eco-design of digital services, which presents developments to support the eco-design of AI-based solutions[115].

116. In addition, a general framework for frugal AI has been developed at the initiative of the French Ministry of Ecological Transition, by AFNOR[116].

117. It is presented as the first international framework for assessing the environmental impact of AI and for enabling companies to report on the frugality of their AI systems[117]. More specifically, the framework provides a definition of "frugal AI," a methodology for life cycle analysis, and a set of best practices for reducing the environmental impact of AI and reporting impact calculations. It also recommends several estimation tools. Such tools are intended to support companies, while also serving as a precursor to standardisation.

118. Several standardisation projects are currently being developed in parallel at both the European and international levels[118].

119. This includes the standardisation project developed by the European Committee for Standardization, in which AFNOR participates, in anticipation of a possible request from the Commission as part of the implementation of the European AI Act, as well as projects (in particular, Project P3710.00) undertaken by the Institute of Electrical and Electronics Engineers (hereinafter "IEEE"), an international professional organisation, and the work of the International Telecommunication Union (hereinafter "ITU"), which is a specialised agency of the United Nations.

120. In addition, at the AI Action Summit in Paris in February 2025, a Coalition for Sustainable AI, led by Ecolab (an entity of the French Ministry of Ecological Transition), was launched by France, the United Nations Environment Programme (UNEP) and the ITU. A roadmap on the standardisation of the environmental impact of AI, aimed at achieving more harmonised guidelines for AI environmental assessment among major international standardisation organisations (International Organization for Standardization [ISO], ITU and IEEE, with the support of UNESCO), was also adopted[119].

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[115] ARCEP and ARCOM, Référentiel général de l'écoconception des services numériques (*General framework for the eco-design of digital services*), May 2024 (French only). See also Ecolab, Hub France IA and AFNOR, Kit d'engagement pour une intelligence artificielle frugale au sein d'une organisation (*Engagement kit for frugal AI within an organisation*), June 2025 (French only).

[116] Référentiel général pour l'IA frugale (English translation available: General framework for frugal AI), AFNOR SPEC 2414, cited above.

[117] https://www.ecologie.gouv.fr/presse/publication-du-referentiel-general-lia-frugale-sattaquer-limpact-environnemental-lia (accessed on 9 December 2025) (French only).

[118] For an overview of the current initiatives, see the work of the Coalition for Sustainable AI, available at https://www.sustainableaicoalition.org/initiatives-hub/ (accessed on 9 December 2025).

[119] See, in particular: https://www.ecologie.gouv.fr/sites/default/files/documents/DP_Coalition_mondiale_IAdurable.pdf (accessed on 9 December 2025) (French only).

121. An increasing number of tools are available for measuring environmental footprint. Examples include:

- tools that focus on measuring energy and carbon footprints (e.g. Green Algorithms);
- tools that offer a complete life cycle analysis (e.g. the tool deployed by Carbone 4 for Mistral);
- tools designed to support the development of frugal AI solutions (e.g. CodeCarbon or CarbonTracker); and
- tools that offer an impact analysis of deployed solutions (e.g. Ecologits or Ecoindex).

122. Some operators are advocating for a step further, namely the introduction of an environmental rating (or score) that would allow for models to be compared based on their environmental impact[120]. In certain respects, the "AI Energy Score" tool – developed notably by Hugging Face – provides a similar function, although it focuses exclusively on the energy consumption of AI models.

2. COMPETITION IMPLICATIONS

123. From a competition perspective, all such initiatives can be seen as a move towards standardisation with a sustainability objective.

124. Insofar as it contributes to sustainability by enabling the development of new frugal products or services, enhancing the frugal attributes of existing offerings, empowering customers to make informed choices based on frugality, and levelling the playing field for competitors with respect to frugality, standardisation will generally have a positive effect on competition[121].

125. However, several competition issues may arise in the context of standardisation[122].

126. To guard against such issues, operators may find it useful to refer to the "soft safe harbour" developed by the Commission in its Guidelines on Horizontal Agreements[123]. On a non-exhaustive basis, this study identifies a number of behaviours that could raise concerns under competition law if adopted by operators in the sector, and urges them to exercise vigilance when engaging in such conduct.

127. Firstly, while the desire to promote frugality in the sector through standardisation may, on a transitional basis, justify the use of imperfect methods or data – notably secondary data, such as sector-specific data, which tends to partially offset the competitive advantages of individual operators –, any standardisation of the environmental footprint, whether through

[120] See, for example, CESE report, cited above, p. 34 and 35. See also Mistral, Notre contribution pour la création d'un standard environnemental mondial pour l'IA (English translation available: Our contribution to a global environmental standard for AI), cited above.

[121] See in this regard, generally, Commission, Guidelines on the Applicability of Article 101 of the Treaty on the Functioning of the European Union to Horizontal Cooperation Agreements, July 2023, paragraph 545. See also *Autorité de la concurrence* Opinion 15-A-16 of 16 November 2015 on the review, under competition rules, of standardisation and certification activities, paragraphs 5 and 6; and Opinion 25-A-01 of 9 January 2025, cited above, paragraphs 77 *et seq*.

[122] See in this regard, generally, Commission, Guidelines, cited above, paragraphs 442 *et seq*.

[123] *Ibid*., paragraph 549.

voluntary standards or footprint calculations, must nonetheless meet quality requirements, based in particular on scientifically robust methods and data.

128. Otherwise, standardisation could – even if unintentionally – result in customers being collectively misled about the true environmental impact of services, and may pose a competition risk if and when environmental impact becomes a competitive parameter[124].

129. Meeting the above-mentioned quality requirements is particularly important in the rapidly evolving AI sector, where methods and data must be updated frequently to reflect current knowledge of environmental impacts. For the same reasons, and to mitigate competition risks, it is essential to ensure that all stakeholders are adequately represented in the standards development process, including, where appropriate, a balance between private sector and public authority interests[125]. Similarly, transparency for users on how the standard works (governance, calculation method, data used, etc.) and third-party verification are key considerations[126].

130. Secondly, standardisation can have an adverse impact on competition if poorly conceived or diverted from its intended purpose. This may be the case, for example, where a standard is biased in favour of certain operators, including as a result of lobbying of public authorities, where it requires information accessible only to specific operators, or where the standard is structured in such a way that a large majority of the products or services offered by the companies subject to the standard can claim a similar benefit, without this reflecting objective characteristics or any efforts to improve those products or services[127].

131. Conversely, standardisation may be impeded by the conduct of certain operators, in particular through strategies aimed at withholding information essential to the development and implementation of the standard or at slowing down or hindering its development process. In certain circumstances, such situations may fall within the scope of competition law, where they result from coordinated behaviour between undertakings or from unilateral conduct by a dominant operator.

132. Thirdly, the development and implementation of standardisation must not give rise to the exchange of commercially sensitive information between competitors, including environmental information, where such exchanges are not objectively necessary for, and strictly proportionate to, standardisation[128].

133. Fourthly, the existence of a plurality of standards, which seems to characterise the AI sector, also calls for a degree of vigilance. The *Autorité* has previously commented on the coexistence of multiple standards and has indicated that such plurality can address different needs, including those not driven by public authorities, may encourage innovation among

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[124] See paragraph 105 above.

[125] Opinion 25-A-01 of 9 January 2025, cited above, paragraphs 168 to 182.

[126] *Ibid.*, paragraphs 152 and 153; Informal Guidance 24-DD-01 of 14 June 2024, cited above, p. 7.

[127] See, in particular, Opinion 15-A-16 of 16 November 2015, cited above, paragraph 7; *Autorité de la concurrence* Decision 17-D-20 of 18 October 2017 regarding practices implemented in the hard-wearing floor coverings sector, paragraphs 388 to 399 and 438; and Opinion 25-A-01 of 9 January 2025, cited above, paragraphs 157 and 208 to 212.

[128] Opinion 25-A-01 of 9 January 2025, cited above, paragraphs 162 to 166; Informal Guidance 24-DD-01 of 14 June 2024, cited above, p. 4.

operators and, in particular, can incentivise standards to evolve their methodologies in order to improve the information provided to consumers[129].

134. However, the exchange of information between standards developers – including the alignment of their strategies and products – must be avoided and, in any event, be objectively necessary for, and strictly limited to, the objectives being pursued by such operators, such as ensuring that standards are comparable at an international level.

135. Lastly, several points of caution must be noted regarding the use of such standards, whether relating to norms, methods for calculating carbon or environmental footprints, or rating indices. In particular, and without questioning the value of beginning work on the environmental footprint with the carbon footprint, the *Autorité* emphasises that standardisation in this area, in any form, must neither limit the incentives for market participants to go beyond the carbon footprint alone, nor mislead customers regarding the overall environmental impact of the AI services offered. Both the terminology used and the ability of operators to go further than proposed by standardisation must be unambiguous[130].

CONCLUSION

136. The emergence and massive deployment of AI are recent, and the impact of AI is still difficult to measure. However, knowledge of, and transparency regarding, the energy and environmental impact of AI are essential to enable consumers, economic operators and public authorities to assess the performance, costs and externalities of the different technologies deployed and services offered. With this in mind, it is important that the ongoing simplification of the Union's environmental rules does not undermine obligations relating to the understanding of, and transparency regarding, the energy and environmental impact of AI.

137. This study highlights three main competition issues linked to the energy and environmental impact of AI: access to energy, the emergence of frugality as a competitive parameter, and the development of standardisation tools for measuring environmental footprint.

138. This study aims to contribute to the ongoing debate on these issues by highlighting several key areas of concern.

139. Firstly, to accurately assess the competitive effects associated with the energy and environmental footprints of AI, reliable data – which appears to be lacking at present – is required. Greater transparency could, on the one hand, prevent a small number of operators from gaining a key advantage through access to such information and, on the other, benefit public research on the subject. Such transparency, including through the implementation of standards, would also ensure that frugality can fully play its role as a competitive parameter.

140. Secondly, access to areas suitable for data centres and to energy, in particular nuclear-generated electricity, must not *de facto* be reserved for the biggest operators only.

[129] Opinion 25-A-01 of 9 January 2025, cited above, paragraphs 78 to 86.

[130] See, in particular, Decision 17-D-20 of 18 October 2017, cited above, paragraphs 436 to 440. See also, for example, Informal Guidance 24-DD-01 of 14 June 2024, cited above, p. 4 to 6.

141. The *Autorité* invites all stakeholders to take note of this study. Moreover, the *Autorité* reminds stakeholders that any suspected anticompetitive practices in the sector can be reported to the *Autorité*, either through a formal referral or via the dedicated reporting platform. Stakeholders can also seek informal guidance from the General Rapporteur of the *Autorité* on the compatibility of their projects with competition rules.