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Abstract

Our society's growing reliance on digital technologies such as AI incurs an ever-growing ecological footprint. The EU regulation of the data centre sector aims to achieve climate-neutral, energy-efficient and sustainable data centres by no later than 2030. This article unpacks the EU law and policy which aims on improving energy efficiency, recycling equipment and increasing reporting and transparency obligations. In 2025 the Commission will present a report based on information reported by data centre operators and in light of the new evidence review the EU policy approach policy. Further regulation should aim to translate reporting requirements into binding sustainability targets to contain rebound effects of the data centre industry while strengthening the public value orientation of the industry.

1. Introduction

The computer, the internet and now artificial intelligence (AI) are heralded as socially disruptive technologies which not only transform the organisation of the economy, business and work but also social institutions, cultural practices and everyday life.[1] Our society's growing reliance on digital technologies also incurs an ever-growing ecological footprint. Data hosting and computing often takes place remotely in large

1 Jeroen Hopster, 'What Are Socially Disruptive Technologies?' (2021) 67 Technology in Society 101750. https://doi.org/10.1016/j.techsoc.2021.101750 accessed 22 October 2024.

warehouses called data centres. Related services are marketed under the 'cloud' metaphor, which evokes a more ephemeral and incorporeal image than what the physical infrastructures and resources required to operate data centres truly are.[2]

Instead it is imperative to address the materiality of computing in order to give due recognition to the significant impact data centres have on our landscapes, energy and water consumption, among others.[3] While it is inconceivable to reap the benefits of digitalisation and AI without the underlying computing infrastructure, the digital sector's energy demand is expected to grow rapidly, especially to power data centres.[4] The key risk that the digital sector poses to sustainability efforts is that, if unchecked, growth in data centres could negate the sector's sustainability gains and even eat away at gains made by improved sustainability of other sectors.[5] In particular, claims that AI will greatly help combat the climate crisis and become a force for sustainability have to first prove that they are merited and would outweigh AI's ecological footprint.

The data centre industry in Europe is booming and highly concentrated, with three US companies dominating the European and global market: Amazon Web Services, Microsoft and Google.[6] Each of these companies has pledged to make significant carbon reductions and power their data centre business with renewable energy by 2030.[7] In addition, data centres also consume a huge amount of water for onsite cooling.[8] All three companies are investing heavily in the development of new data centres to facilitate the growth of AI, casting doubt over their sustainability pledges and undermining commitments to consume less water.[9]

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2 As Bratton puts it: 'There is nothing immaterial about massless information that demands such energy from the Earth.', Benjamin H Bratton, *The Stack: On Software and Souvereignty* (MIT Press 2015) 29; Carr and others ascribe to large digital corporations that 'the notion of cloud' is in line with their practice of obscurity', Constance Carr and others, 'Mapping the Clouds: The Matter of Data Centers' (2022) 18 Journal of Maps 106, 106; See also Ensmenger N, 'The Cloud Is a Factory', in Thomas S. Mullaney, Benjamin Peters, Mar Hicks and Kavita Philip (eds), Your Computer is on Fire (MIT Press 2021) https://doi.org/10.7551/mitpress/10993.003.0005 accessed 22 October 2024

3 Louise Amoore, 'Cloud Geographies: Computing, Data, Sovereignty' (2018) 42 Progress in Human Geography 4, 8; Federica Lucivero, 'Big Data, Big Waste? A Reflection on the Environmental Sustainability of Big Data Initiatives' (2020) 26 Science and Engineering Ethics 1009, 1019–1020, 1025–26; Ensmenger (n 2) 34.

4 Nic Fildes and Antoine Gara, 'Australian Pension Fund Buys into European Data Centres to Tap AI Boom' *Financial Times* (11 September 2023) https://www.ft.com/content/f785578d-06df-4e58-b47e-4609d8a4b104 accessed 17 April 2024; Angus Loten, 'Private-Equity Firms Snap Up Data Centers as Cloud Demand Soars' *Wall Street Journal* (23 February 2023) https://www.wsj.com/articles/private-equity-firms-snap-up-data-centers-as-cloud-demand-soars-68aaa6a0 accessed 30 October 2023; Elaine Moore, 'Data Centres Have Turned Big Tech into Big Spenders' *Financial Times* (London, 16 May 2024) https://www.ft.com/content/f8e4dac5-5869-4db9-b4ba-1398408e3962 accessed 29 May 2024.

5 Carolina Koronen, Max Åhman and Lars J Nilsson, 'Data Centres in Future European Energy Systems—Energy Efficiency, Integration and Policy' (2020) 13 Energy Efficiency 129; Roger Fouquet and Ralph Hippe, 'Twin Transitions of Decarbonisation and Digitalisation: A Historical Perspective on Energy and Information in European Economies' (2022) 91 Energy Research & Social Science 102736.

6 Netherlands Authority for Consumers and Markets (ACM), 'Market Study Cloud Services' ACM/INT/440323 https://www.acm.nl/system/files/documents/public-market-study-cloud-services.pdf accessed 17 July 2024, 4,7,37; UK Office of Communications (Ofcom), 'Cloud Services Market Study Interim Report' (2022) 34–37 https://www.ofcom.org.uk/siteassets/resources/documents/consultations/category-3-4-weeks/244808-cloud-services-market-study/associated-documents/cloud-services-market-study-final-report.pdf?v=330228

7 See e.g. 'Driving Climate Solutions' (Amazon Sustainability) https://sustainability.aboutamazon.com/climate-solutions accessed 12 August 2024; Brad Smith, 'Microsoft Will Be Carbon Negative by 2030' (The Official Microsoft Blog, 16 January 2020) https://blogs.microsoft.com/blog/2020/01/16/microsoft-will-be-carbon-negative-by-2030/ accessed 3 July 2024; 'Aiming to Achieve Net-Zero Emissions - Google Sustainability' (Google Sustainability) https://sustainability.google/operating-sustainably/net-zero-carbon/ accessed 3 July 2024.

8 David Mytton, 'Data Centre Water Consumption' (2021) 4 npj Clean Water 1.

9 Dan Milmo and Alex Hern, 'AI Drive Brings Microsoft's "Green Moonshot" down to Earth in West London' *The Guardian* (29 June 2024) https://www.theguardian.com/business/article/2024/jun/29/ai-drive-brings-microsofts-green-moonshot-down-to-earth-in-west-london accessed 1 July 2024; Dan Milmo and Dan Milmo Global technology editor, 'Google's Emissions Climb Nearly 50% in Five Years Due to AI Energy Demand' *The Guardian* (2 July 2024) https://www.theguardian.com/technology/article/2024/jul/02/google-ai-emissions accessed 3 July 2024; Pascale Davies 'Energy-Intensive Data Centres Are on the Rise in Europe Thanks to AI' *euronews* (12 September 2024) https://www.euronews.com/next/2024/09/11/europe-to-see-168-increase-in-data-centre-investment-as-european-commission-awaits-energy- accessed 27 September 2024; Pengfei Li and others, 'Making AI Less "Thirsty": Uncovering and Addressing the Secret Water Footprint of AI Models' http://arxiv.org/abs/2304.03271 accessed 20 March 2024.

Though less prominently discussed, data centres are also key sources of electronic waste and waste heat, which adds to problems of pollution and impacts biodiversity in local areas.[10]

At the European Union (EU) level, the Green Industrial Plan for the Net Zero Age declared a 'twin transition of digitalisation and decarbonisation'[11] in line with the goals of the EU Green Deal to achieve climate neutrality by 2050.[12] Already in 2020 the Commission's strategy 'Shaping Europe's Digital Future' announced 'initiatives to achieve climate-neutral, highly energy-efficient and sustainable data centres by no later than 2030'.[13] No longer does EU policy exclusively rely on the data centre sector to pursue its sustainability through voluntary initiatives such as operators' own corporate social responsibility pledges and non-binding industry standards and guidelines.[14] Rather, the EU has adopted a string of legislative initiatives, largely focusing on energy efficiency, in pursuit of the 2030 aim for data centres' sustainability.

Predominantly, the literature on sustainability and fighting the climate crisis recognises the significant role digital technologies can play in achieving sustainability goals. Nonetheless, there is increasing recognition of the digital sector's own growing ecological footprint and consequently the need to make digital technologies themselves meet sustainability targets.[15] In addition to engineering, data and computer science,[16] data centre growth and its implications for sustainability have received increased attention in recent years from the social sciences and humanities, including media and social studies,[17] political geography,[18] ethics[19] and history.[20] With the rising of AI applications since 2023, a recent body of social science literature focuses exclusively on AI and sustainability.[21] Data centre sustainability has also received growing consideration from multi-disciplinary fields in sustainability, such as the study of energy systems and energy efficiency,[22] and water consumption.[23]

10 Commission, 'Digital Solutions for Zero Pollution' SWD (2021) 140 final, 7; Ran Liu and others, 'Impacts of the Digital Transformation on the Environment and Sustainability' (Institute for Applied Ecology 2019).

11 Commission, 'A Green Deal Industrial Plan for the Net-Zero Age' (Communication) COM (2023) 62 final.

12 Commission, 'The European Green Deal' (Communication) COM(2019) 640 Final, 4; Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 (European Climate Law), OJ 2021 L 243/1 arts 2, 5.

13 Commission, 'Shaping Europe's Digital Future' (Communication) COM(2020) 67 Final, 12.

14 Václav Ocelík, Business-to-Government Relations in the Digital Age: Corporate Responses to Policy Making (Phd thesis University of Amsterdam 2024), 166.

15 Fouquet and Hippe (n 5) 15–16.

16 Li and others (n 9).

17 Karin van Es, Daan van der Weijden and Jeroen Bakker, 'The Multifaceted and Situated Data Center Imaginary of Dutch Twitter' (2023) 10 Big Data & Society; Julia Rone, 'The Shape of the Cloud: Contesting Data Centre Construction in North Holland' [2023] New Media & Society 1; Josh Cowls and others, 'The AI Gambit: Leveraging Artificial Intelligence to Combat Climate Change—Opportunities, Challenges, and Recommendations' (2023) 38 AI & Society 283.

18 Carr and others (n 2).

19 Aimee van Wynsberghe, 'Sustainable AI: AI for Sustainability and the Sustainability of AI' (2021) 1 AI and Ethics 213; Sophia Falk and Aimee van Wynsberghe, 'Challenging AI for Sustainability: What Ought It Mean?' [2023] AI and Ethics https://doi.org/10.1007/s43681-023-00323-3 accessed 4 September 2024; Lucivero (n 3).

20 Rihards Balodis and Inara Opmane, 'History of Data Centre Development' in Arthur Tatnall (ed), *Reflections on the History of Computing: Preserving Memories and Sharing Stories* (Springer Berlin Heidelberg 2012).

21 Cowls and others (n 17); Sophia Falk and Aimee van Wynsberghe, 'Challenging AI for Sustainability: What Ought It Mean?' [2023] AI and Ethics https://doi.org/10.1007/s43681-023-00323-3; Alex De Vries, 'The Growing Energy Footprint of Artificial Intelligence' (2023) 7 Joule 2191; Kenddrick Chan and others, 'Greening AI: A Policy Agenda for the Artificial Intelligence and Energy Revolutions' (Tony Blair Institute for Global Change 2024) https://www.institute.global/insights/climate-and-energy/greening-ai-a-policy-agenda-for-the-artificial-intelligence-and-energy-revolutions accessed 12 August 2024.

22 Koronen, Åhman and Nilsson (n 5); Fouquet and Hippe (n 5).

23 Mytton (n 8); Li and others (n 9).

Within legal scholarship, the link between sustainability and digital technologies has been recognised.[24] In comparison to other disciplines, however, discussion of sustainable data and computing infrastructures in legal scholarship has been relatively limited.[25] Digital sustainability is instead approached through the analysis of legislative efforts to regulate the energy consumption of AI[26] and Bitcoin mining.[27] The majority of the literature concerning data centres' sustainability by contrast are EU policy documents and commissioned studies which approach data centres as objects of sustainability policy.[28] The governance of data centres has also received attention from research institutes, NGOs and think tanks.[29]

This article will provide an overview of the law and policy addressing data centre sustainability in the EU and analyse the EU policy discourse underpinning the current regulatory framework. The article expands its focus from AI to analyse the data centre sector more broadly, which provides the data centre and computing infrastructure for not only AI, but also cloud services and the digital economy. This article seeks to critically engage with the current regulatory approach and suggest what is needed to reach the EU's 2030 sustainability targets. Therefore, the article's findings will be of relevance for researchers, policy makers and other stakeholders concerned with the integration of sustainability policy and the data centre sector.

What is not covered in this article but forms part of the legal puzzle is the law applicable to data centres' development and construction which is commonly governed by EU Member States' national law. At the Member States' level different legal and regulatory domains are relevant to data centres' development and construction, which cut across spatial planning, environmental regulation, and construction law which typically require government authorizations. It is noticeable that at the local level resistance against very large data centres has been mounting over the lack of transparency and public participation surrounding

24 Carlos Gómez Ligüerre and Lela Mélon, 'Online Platforms and Sustainability: How to Engage Digital Intermediaries in Sustainability Goals', *Routledge Handbook of Private Law and Sustainability* (1st Edn, Routledge 2024); Eduard Fosch-Villaronga, Hadassah Drukarch and Marco Giraudo, 'A Legal Sustainability Approach to Align the Order of Rules and Actions in the Context of Digital Innovation' in Henrik Skaug Sætra (ed), *Technology and Sustainable Development* (Routledge 2023); Michèle Finck and Marie-Sophie Mueller, 'Access to Data for Environmental Purposes: Setting the Scene and Evaluating Recent Changes in EU Data Law' (2023) 35 Journal of Environmental Law 109.

25 One of the leading edited volumes on the topic does not mention environmental issues or sustainability, see Christopher J Millard, *Cloud Computing Law* (2nd edn, Oxford University Press 2021).

26 Philipp Hacker, 'Sustainable AI Regulation' (2024) 61 Common Market Law Review 345; Alba Perez Victorio, Edoardo Celeste and Alberto Quintavalla, 'Greening AI? The New Principle of Sustainable Digital Products and Services in the EU' (2024) Common Market Law Review 1019; Alesia Zhuk, 'Artificial Intelligence Impact on the Environment: Hidden Ecological Costs and Ethical-Legal Issues' (2023) 1 Journal of Digital Technologies and Law 932, 940.

27 Jon Truby, 'Decarbonizing Bitcoin: Law and Policy Choices for Reducing the Energy Consumption of Blockchain Technologies and Digital Currencies' (2018) 44 Energy Research & Social Science 399; Robert Herian, *Regulating Blockchain: Critical Perspectives in Law and Technology* (Routledge 2018).

28 Commission and others, 'Ecodesign Preparatory Study on Enterprise Servers and Data Equipment' (Publications Office of the European Union 2014) https://data.europa.eu/doi/10.2873/14639 accessed 17 June 2024; Commission and others, *Energy-Efficient Cloud Computing Technologies and Policies for an Eco-Friendly Cloud Market: Final Study Report.* (Publications Office of the European Union 2020) https://data.europa.eu/doi/10.2759/3320 accessed 4 July 2024; Commission and others, *Study on Greening Cloud Computing and Electronic Communications Services and Networks towards Climate Neutrality by 2050 : Final Study Report* (Publications Office of the European Union 2022) https://ec.europa.eu/newsroom/dae/redirection/document/84281 accessed 17 June 2024.

29 Between 2021 and 2022, the Uptime Institute published a series of reports on sustainability issues related to the data centre industry, e.g. David Mytton, 'Renewable Energy for Data Centers: Renewable Energy Certificates, Power Purchase Agreements and Beyond' (Uptime Institute 2021) UII-44 v1.0P https://uptimeinstitute.com/renewable-energy-for-data-centers accessed 1 October 2024; Andy Lawrence, 'The Gathering Storm: Climate Change and Data Center Resiliency' (Uptime Institute 2021) UII-41 v1.1 https://uptimeinstitute.com/resources/research-and-reports accessed 1 October 2024; Hannah Daly, 'Data Centres in the Context of Ireland's Carbon Budgets' (2024) https://www.friendsoftheearth.ie/publications/data-centrres-and-the-carbon-budgets-prof-hannah-daly-dec-20/ accessed 9 January 2025; Eef Masson, Gido van Rooijen and Rinie van Est, 'Beter Beslissen over Datacentra – De Noodzaak van Een Breed Publiek Perspectief Op de Digitale Infrastructuur' (Rathenau Instituut 2022) https://www.rathenau.nl/nl/digitalisering/beter-beslissen-over-datacentra accessed 2 November 2023; Catherine Banet and others, 'Data Centres & the Grid – Greening ICT in Europe' (Centre on Regulation in Europe 2021) https://cerre.eu/wp-content/uploads/2021/10/211013_CERRE_Report_Data-Centres-Greening-ICT_FINAL.pdf accessed 19 June 2024.

data centre development and the potential impacts thereof on local sustainability efforts.[30] What also falls outside this article's scope are national responses to cope with the significant pressure data centres growth places on local energy grids.[31]

This article harnesses mixed methods. In order to provide a concise introduction to the data centre and sustainability issue a descriptive approach was used that integrates the multidisciplinary literature. For the description of the applicable legal framework, legal doctrinal analysis was used to identify and interpret the law related to data centres, while discourse analysis was applied to examine the policy considerations underpinning the sustainable data centre regulations. Relevant policy documents of the European Commission (the Commission), the European Parliament (the Parliament), the European Council (the Council) and Committee of the Regions from the period 2019-2024 were analysed, including Commission Communications and Staff Working Documents (SWD) and deliberations from EU legislative procedures. While this article is about the EU law and policy of data centre' sustainability, owing to the domain and regulatory approach, it can at times become quite a technical reading.

This article will begin by outlining in Section 2 what characterises data centres and the cloud services market in Europe, before explaining the various environmental impacts of data centres' operations. Section 3 will then move to EU law and provide an overview of the legislation and relevant policies which are addressed to operators and providers of data centres and – in the case of environmental reporting obligations – to the users of digital services. In Section 4, the paper will present the EU policy discourse, suggesting pathways forward.

2. A primer on data centres, markets and sustainability

The section will begin by explaining what a data centre is and providing an overview of the different types of data centres, before turning to the data centre industry and market in Europe. The various impacts of data centres on the environment will be introduced, including energy consumption and carbon footprint, water use and consumption for cooling and the associated problem of waste heat, and overall electronic waste.

2.1 Data centres: An explainer

Different to the definition of cloud computing, there is no uniformly accepted definition of data centres.[32] The broadest definition of data centre in the EU context has been developed by the European Committee for Electrotechnical Standardisation (CENELEC):

> 'A structure, or group of structures, dedicated to the centralised accommodation, interconnection and operation of information technology and network telecommunications equipment providing data storage, processing and transport services together with all the

30 An infamous example from the Netherlands is 'Operation Tulip', a covert attempt by Meta, using a shell company, to develop what would have been the largest hyperscale data centre in the Netherlands. The key issues raised were that the data centre would use a considerable amount of the community's renewable energy resources, as well as potentially pollute local water supplies, all while providing few jobs or economic benefit to the local community, see Rone (n 17); Aman Sethi, 'Operation Tulip : Inside Facebook's Secretive Push To Build Holland's Biggest Data Center' (*Buzzfeed News*, 7 January 2022) https://www.buzzfeednews.com/article/amansethi/operation-tulip-inside-facebooks-secretive-push-to-build accessed 18 January 2024; Tracey Brown Hamilton, 'In a Small Dutch Town, a Fight with Meta over a Massive Data Center' (*Washington Post*, 1 June 2022) https://www.washingtonpost.com/climate-environment/2022/05/28/meta-data-center-zeewolde-netherlands/ accessed 22 July 2024.

31 For example, in Ireland, the national electricity grid operator, EirGrid, issued a temporary moratorium on new data centres in the Dublin area, in reaction to a 400% increase in under a decade: Marese McDonagh, 'Climate activists raise questions about who benefits from Leitrim wind farms' *The Irish Times* (12 August 2023) https://www.irishtimes.com/environment/climate-crisis/2023/08/11/climate-activists-raise-questions-about-who-benefits-from-leitrim-wind-farms/; see e.g. about Norway which is a member state of the European Economic Area, Jonathan Yerushalmy, 'Norwegian Company Says TikTok Data Centre Is Limiting Energy for Manufacturing Ukraine Ammunition' *The Guardian* (28 March 2023) https://www.theguardian.com/technology/2023/mar/28/energy-hungry-tiktok-data-centre-ukraine-ammunition-production-nammo-norway accessed 25 October 2023.

32 National Institute of Standards and Technology (NIST), *The NIST Definition of Cloud computing* (Special Publication 800-145), 2011 https://doi.org/10.6028/NIST.SP.800-145 (accessed 9 October 2024); NIST, Evaluation of Cloud Computing Services Based on NIST SP 800-145 (Special Publication 500-322) 2018, https://doi.org/10.6028/NIST.SP.500-322 (accessed 9 October 2024).

> facilities and infrastructures for power distribution and environmental control together with the necessary levels of resilience and security required to provide the desired service availability.'[33]

The following, shorter definition of data centres has been included in EU legislation:

> 'industrial structures or groups of structures used to house, connect and operate computer systems, servers and associated equipment for data storage, processing and distribution, as well as other related activities.'[34]

In practice, data centres are rather faceless warehouses which house rows of racks full of hardware such as servers, graphics processing units (GPUs), storage systems and other equipment.

There are a number of ways to classify different types of data centres. They are commonly classified according to their floor size and power capacity. 'Small' data centres have a floor size of 100 m² to 1000 m², with 6-200 racks and a power capacity of 50 kW to 1 MW, while 'large' data centres have a floor size of 1000 m² - 10.000 m², with 200-2000 racks and a power capacity of 1 MW to 10 MW.[35] The type of data centres that have attracted the most attention, are 'hyperscale' data centres, which have a floor size of over 10.000 m², with 2000+ racks and a power capacity of over 10 MW.[36] This is equivalent to 1.36 soccer fields or roughly one city block in Manhattan. In practice, hyperscale data centres can be much larger than this, with the largest in Europe, located in Portugal, measuring 74.322 m² or seven soccer fields.[37]

Data centres may also be differentiated by function. 'Enterprise' data centres are operated by any entity, such as a government, public sector or commercial enterprise, to deliver and manage services to its own employees and customers.[38] In a 'colocation' data centre, multiple customers locate their own networks, servers and storage equipment, with the data centre operator supplying the support infrastructure of the building, including power, cooling and connectivity.[39] In 'co-hosting' data centres, the operator supplies the support infrastructure and ICT equipment as a service, which gives multiple customers access to networks, servers and storage equipment, on which they operate their own services and applications.[40] In a 'hosting' data centre, the ownership of the infrastructure and equipment is common but the software systems are dictated by the customers.[41] A Commission study has also recommended the adoption of a definition of a 'hybrid' data centre, where the data centre operator owns the building, support infrastructure and some of the ICT equipment, with customers owning the rest of the ICT.[42]

The industry itself, including data centre users, consultants and design professionals, uses a tier level system to classify the data centre building, the Data Centre Tier Performance Standards.[43] The Tiers provide a 'design-versus-performance' ranking approach, with each Tier, ranging from I-IV, matching a particular

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33 CEN/CLC/ETSI Joint Coordination Group Green Data Centres, 'Standardisation Landscape for the Energy Management and Environmental Viability of Data Centres (10th Edition)' (2023) 9 https://www.cencenelec.eu/media/CEN-CENELEC/AreasOfWork/CEN%20sectors/Digital%20Society/Green%20Data%20Centres/standardizationlandscapegdcedition10_2023.pdf accessed 22 July 2024.

34 Directive 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 2023 L 231/1 (EED), art 2(49) referring to Commission Regulation (EU) 132/2022 of 28 January 2022 amending Regulation (EC) No 1099/2008 of the European Parliament and of the Council on energy statistics, as regards the implementation of updates for the annual, monthly and short-term monthly energy statistics, OJ 2022 L 20/208, Annex A 2.6.3.1.16.

35 Commission and others, *Study on Greening Cloud Computing* (n 28).

36 Commission and others, *Study on Greening Cloud Computing* (n 28) 71.

37 Maya Derrick, 'Top 10 Largest Data Centres in Europe' (*Data Centre Magazine*, 6 September 2023) https://datacentremagazine.com/top10/top-10-largest-data-centres-in-europe accessed 12 August 2024.

38 CEN/CLC/ETSI Joint Coordination Group Green Data Centres (n 33) 9.

39 Commission and others, *Study on Greening Cloud Computing* (n 28).

40 CEN/CLC/ETSI Joint Coordination Group Green Data Centres (n 33) 9.

41 CEN/CLC/ETSI Joint Coordination Group Green Data Centres (n 33) 10.

42 Commission and others, *Study on Greening Cloud Computing* (n 28) 70.

43 Balodis and Opmane (n 20).

business function, maintenance, power, cooling and fault capabilities.[44] The latter ranges from 'basic' fault capability in Tier I, where sitewide shutdowns are required for maintenance, to 'fault tolerant' in Tier IV, where interruptions or equipment failures do not impact operations.[45] This higher availability requires backup energy systems, such as diesel generators[46] and, increasingly, batteries.[47]

2.2 Data centre industry and markets in Europe

Official data on market shares in the European data centre market are not available, therefore cloud market shares are used as proxies for data centre capacity in Europe in this section. The demand for cloud services in Europe is booming, with the market growing by 20-30% each year since 2017 and revenues amounting to €65 billion in 2021.[48] According to industry sources, the biggest data centre clusters are in Frankfurt, London, Amsterdam, Paris and Dublin (known as FLAP-D).[49] Secondary markets in Berlin, Brussels, Madrid, Milan, Munich, Oslo, Stockholm, Warsaw, Vienna, and Zurich have also seen growth.[50]

When looking at the European cloud computing market and correspondingly to data centres, the key players are non-European. The three largest cloud service providers are Amazon, Microsoft and Google respectively.[51] Microsoft and Amazon have large market shares with between 35-40% of the market each.[52] Google is a close third competitor.[53] There are other key US based service providers, including IBM, Oracle and VMware.[54] While the European cloud providers market share is significantly less than that of their US counterparts, reaching around 15%, important providers include OCH Cloud, Deutsche Telecom and NorthC Group.[55] In addition, many data centres are also owned by real estate funds, such as Equinix and Digital Realty.[56]

The three largest providers, Amazon, Microsoft and Google have committed to significant improvements on their carbon emissions and related sustainability impacts. In 2019 Amazon pledged to powering all operations, including data centres, with 100% renewable energy by 2030 and to achieve net-zero carbon emissions by 2040.[57] Microsoft has committed to three sustainability improvements; firstly to be 'carbon negative' by 2030 and to remove its historic carbon emissions by 2050.[58] Google has made similar pledges, setting the goal of achieving net-zero emissions across all operations by 2030 and to operate all data centres on carbon-free energy.[59] However, the advent of AI has resulted in each company increasing investment in

44 'Tier Classification System' (*Uptime Institute*) https://uptimeinstitute.com/tiers accessed 12 July 2024.

45 Balodis and Opmane (n 20).

46 Banet and others (n 29) 19.

47 Peter Judge, 'Microsoft Replaces Diesels with Battery System at Swedish Data Center' (*Data Center Dynamics*, 4 October 2023) https://www.datacenterdynamics.com/en/news/microsoft-replaces-diesels-with-battery-system-at-swedish-data-center/ accessed 12 August 2024.

48 Netherlands Authority for Consumers and Markets (n 6) 33.

49 CBRE 'Figures Europe Data Centres Q4 2024 (2025) https://mktgdocs.cbre.com/2299/b43a543c-b538-4e88-8c59-2f05aa86050a-1219342128/Europe_Data_Centres_Figures_Q4.pdf accessed 28 February 2025

50 CBRE (n 49) 1.

51 Ofcom (n 6) 34.

52 ACM (n 6) 4.

53 ACM (n 6) 4.

54 ACM (n 6) 37.

55 Others include French provider Scaleway, German provider Deutsche Telekom Schwarz Group, and Dutch operators such as Leaseweb, Uniserver and ODC Noord, Netherlands Authority for Consumers and Markets (n 6) 37–38.

56 Josephine Walbank, 'The World's Top 10 Data Centre REITs' (*Data Centre Magazine*, 3 August 2022) https://datacentremagazine.com/articles/top-10-data-centre-reits accessed 7 February 2025. Daniel Greene, 'Landlords of the Internet : Big Data and Big Real Estate', (2022) 52 Social Studies of Science 6, 904-927.

57 'Driving Climate Solutions' (*Amazon Sustainability*) https://sustainability.aboutamazon.com/climate-solutions accessed 12 August 2024.

58 This includes procuring renewable energy globally by 2025 and eliminating dependence on diesel fuel for backup generators in 2030. Microsoft has also committed to being 'water positive' by replenishing more water than it consumes locally by 2030 and to being 'zero waste' by 2030, through waste reduction and recycling. Brad Smith, 'Microsoft Will Be Carbon Negative by 2030' (*The Official Microsoft Blog*, 16 January 2020) https://blogs.microsoft.com/blog/2020/01/16/microsoft-will-be-carbon-negative-by-2030/ accessed 3 July 2024.

59 'Aiming to Achieve Net-Zero Emissions - Google Sustainability' (*Google Sustainability*) https://sustainability.google/operating-sustainably/net-zero-carbon/ accessed 3 July 2024.

data centre capacity so as to stay abreast with the training and operation of large AI models. Google has admitted 'significant uncertainty' around reaching its target after its emissions rose 50% since 2019, while Microsoft says energy consumption of its data centres is endangering its pledge.[60]

It is important to note that data centres are not necessarily constructed to cater for local, national or even regional demands,[61] but as building blocks in a planetary scale computing infrastructure.[62] From a technical point of view, customers and users do not need to be in the proximity of a given data centre, as long as internet connectivity is fast and reliable. Due to a lack of data, it is not clear how much data centre capacity in a given location is used to supply local or regional businesses and organisations, or to satisfy international demand.[63] Being part of a global computing stack leads to interdependencies between the EU and other regions. Equally, a decision not to build a data centre in a particular location, whether due to denial of permission or public opposition does not prevent the data centre being built elsewhere in Europe, or the world. This is referred to as 'the waterbed effect' by climate economists: one government's actions generates repercussions in other states.[64]

2.3 Sustainability issues posed by data centres

The key sustainability impacts computing in data centres pose include growing energy and water consumption, the production of ICT equipment and resulting electronic waste which will be covered below. Other sustainability issues which are not included in this article are the use of certain greenhouse gases (GHG) in refrigerants and land on which data centers are constructed.

2.3.1 Energy consumption, carbon footprint and attribution

It is important to distinguish between a data centre's *energy* footprint and its *carbon* footprint: *energy* footprint refers to the amount of energy (usually in the form of electricity) a data centre consumes, while *carbon* footprint refers to how much GHG emissions it generates and embodies.[65] The energy footprint can be derived from the electricity a facility consumes. A common metric used by the sector is Power Usage Effectiveness (PUE). This measures a data centre's energy efficiency, calculated by dividing the total facility power by the power consumption of the IT equipment. According to the current state of the industry, on average PUE tends to be approximately 1.56 with state of the art facilities achieving a PUE of 1.3.[66] On average 60% of the electricity is used for computing and other associated equipment, such as power supply systems, storage device and communication equipment, while 40% is used for cooling.[67]

There is considerable uncertainty regarding the exact electricity consumption of ICT, with most of the estimates focusing on global data centre electricity use.[68] Depending on the proxy used, these estimates differ vastly. Masanet et al arrived at one of the most conservative estimates, arguing in 2020 that there is sufficient energy efficiency resource to absorb the next doubling in data centre compute instances, resulting

60 Dan Milmo, 'Google's emissions climb nearly 50% in five years due to AI energy demand' *The Guardian* (2 July 2024) https://www.theguardian.com/technology/article/2024/jul/02/google-ai-emissions accessed 5 September 2024; Milmo and Hern (n 9); 'Davies' (n 9).

61 Masson, van Rooijen and van Est (n 29) 35–37.

62 Bratton (n 2).

63 According to a 2021 study commissioned by the Dutch government for instance, domestic demand was estimated to be equivalent to 25-35% of all data centre capacity in the Netherlands. Equally Dutch organisations and consumers also make use of data centre capacity provided across borders This estimate has likely already changed considering that the demand for data centre capacity has been growing everywhere, as has the available capacity in the Netherlands. Buck Consultants Int., 'Verkenning relatie tussen accommoderen datacentervraag en digitaliseringskansen, June 2021' https://open.overheid.nl/documenten/ronl-2bb4ce6e-9ea1-41fc-8796-d89418311a375/pdf accessed 15 July 2024.

64 For example see Thomas Eichner and Rüdiger Pethig, 'EU-Type Carbon Regulation and the Waterbed Effect of Green Energy Promotion' (2019) 80 Energy Economics 656, 303; Knut Einar Rosendahl, 'EU ETS and the Waterbed Effect' (2019) 9 Nature Climate Change 734.

65 David Mytton and Masaō Ashtine, 'Sources of Data Center Energy Estimates: A Comprehensive Review' (2022) 6 Joule 2032.

66 Douglas Donnellan and others, 'Uptime Institute Global Data Center Survey 2024' (Uptime Institute 2024) 7 https://datacenter.uptimeinstitute.com/rs/711-RIA-145/images/2024.GlobalDataCenterSurvey.Report.pdf?version=0 accessed 27 January 2025.

67 International Energy Agency, 'Electricity 2024 - Analysis and Forecast to 2026' (2024) 31 https://iea.blob.core.windows.net/assets/6b2fd954-2017-408e-bf08-952fdd62118a/Electricity2024-Analysisandforecastto2026.pdf accessed 22 July 2024.

68 International Energy Agency (n 67) 34.

in global data centre energy use only rising slightly.[69] Based on a 340% increase in data centre workloads between 2015 and 2022, in 2024 the IEA estimates that globally, data centre energy usage (excluding cryptocurrency) grew from 200 TWh to between 240-340 TWh in the same period. Including cryptocurrency and AI trends, the IEA estimates a potential global growth in electricity consumption to over 800 TWh in 2026.[70] De Vries has estimated the impact of AI on data centre energy consumption based on the sale of chips by NVIDIA, suggesting that companies investing in AI could see their electricity consumption double. According to his estimate, based on NVIDIA being able to ship 1.5 million of its AI servers, this alone could consume 85.4-134 TWh in 2027.[71] If data centre energy consumption is correlated with rapid growth in network traffic, Andrae has estimated that centres are using between 366 TWh and 974 TWh of energy in 2030.[72]

Though most of the estimates focus on global electricity usage, the IEA estimates that data centre electricity consumption in 2022 was around 4% of all EU total energy demand, at just below 100 TWh and suggests that this could grow to 150 TWh in 2026.[73] The majority of data centres are concentrated in the FLAP-D cities, meaning the burden of this increase in electricity consumption is not spread evenly across EU Member States. For example, it estimated that Ireland and Denmark alone with will make up 20% of the increase in data centres in Europe.[74] Local concentration of data centre growth also implies that some local communities, regions and Member States are more affected than others.

The carbon footprint of a data centre depends on how much GHG emissions are created by the data centre's operation. This not only covers GHG emissions from carbon-based electricity but also depending on the type of refrigerant used or whether backup generators or natural gas heating and generation systems are utilised. Carbon footprint can be reduced by onsite measures, (such as solar panels or using different refrigerants) or offsite measures, such as purchasing renewable energy. To truly know how much GHG emissions are being produced by a data centre, location based emissions that report the actual emissions generated by the data centre are necessary. However, there is a problem where data centre operators purchase renewable energy offsite but do not directly consume it onsite. Though the data centre industry leads in the purchasing of renewable energy certificates, this does not guarantee that this renewable energy is used onsite by the data centre. There is controversy over how renewable energy certificates and offsets should be included in reporting.[75] In particular it is argued that their inclusion can be misleading to stakeholders and the public, as it allows companies to meet their targets, without reducing their total emissions.[76]

Equally, there is still limited amount of renewable energy available for purchase in the EU: in 2022 fossil fuels still made up 38.6% of electricity generation.[77] Note also that most data centres still have back-up generators, usually diesel powered, which are constantly on standby in case of an outage in the primary electricity source.[78] This means that even if a data centre primarily runs on renewable energy, it still has a carbon footprint.[79]

69 Though they emphasise that there must be sufficient measures taken to manage a sharp energy demand growth; see Eric Masanet and others, 'Recalibrating Global Data Center Energy-Use Estimates' (2020) 367 Science 984.

70 International Energy Agency (n 67) 31.

71 De Vries (n 21).

72 Anders SG Andrae, 'New Perspectives on Internet Electricity Use in 2030' (2020) 3(2) Engineering and Applied Science Letters 19, 24.

73 International Energy Agency (n 67) 32.

74 International Energy Agency (n 67) 20.

75 Isabel O'Brien, 'Data Center Emissions Probably 662% Higher than Big Tech Claims. Can It Keep up the Ruse?' *The Guardian* (15 September 2024) https://www.theguardian.com/technology/2024/sep/15/data-center-gas-emissions-tech accessed 4 October 2024.

76 Anders Bjørn and others, 'Renewable Energy Certificates Threaten the Integrity of Corporate Science-Based Targets' (2022) 12 Nature Climate Change 539.

77 European Council and Council of the European Union, 'How Is EU Electricity Produced and Sold?' (*Consilium*) https://www.consilium.europa.eu/en/infographics/how-is-eu-electricity-produced-and-sold/ accessed 22 July 2024.

78 Banet and others (n 29) 19.

79 Walt Coulston, 'Is It Time to Replace Diesel Backup Generators?' (*Data Center Dynamics*, 26 August 2023) https://www.datacenterdynamics.com/en/opinions/is-it-time-to-replace-diesel-backup-generators/ accessed 22 July 2024.

A data centre's carbon footprint or GHG emissions can be further categorised into Scope 1, 2 and 3 emissions (See Table 1 below). Scope 1 emissions are direct GHG emissions that occur from sources that are owned or controlled by an entity, while Scope 2 emissions relate to GHG emissions from purchased electricity consumed by the entity.[80] Scope 3 emissions are indirect emissions resulting from activities from other sources occurring in that entity's supply chain. Data centre electricity usage for powering equipment and cooling can be classed as Scope 2 emissions. Use of data centre services by customers and users of cloud technology are key sources of Scope 3 emissions.[81] Scope 3 emissions are the most difficult to measure as they require calculating the GHG emissions produced by others within the value chain such as customers when utilising cloud infrastructure or during the production of the IT equipment.[82] Given increasing digitalisation in all sectors of the economy, data centres will be part of the scope 3 emissions of many sectors.

Table 1. Scope 1, 2 and 3 emissions of data centres operators, from the view of the operator.[83]

Scope	Explanation	Data Centre Examples
Scope 1 (Direct emissions)	Emissions from operations directly owned or controlled by the data centre	Direct emissions from backup generators, refrigerant and natural gas heating/ generation systems
Scope 2 (Indirect emissions)	Indirect emissions from the generation of purchased or acquired energy (electricity, heating, cooling)	Indirect emissions from carbon-based electricity and purchased/sold heating or cooling
Scope 3 (Indirect emissions)	All indirect emissions which result from the data centre's activities	Including but non-exhaustive – Purchased goods and services (servers, racks, generators, cooling equipment – Transportation and distribution – Construction, including materials – End of life and disposal of equipment – Energy used downstream as a result of business activity – Business travel – Employee commuting

Depending on the type of data centre, and the type of cloud services model provided by the operator, activities may fall into different scopes.[84] For example, in a colocation data centre (where the provider supplies the building and support infrastructure and the customers supply their own equipment) the customer is responsible for the Scope 2 emissions from the energy acquired to power the ICT equipment. This will instead form part of the provider's Scope 3 emissions. This is different to a 'co-hosting data centre' (where the provider supplies the building, support infrastructure and ICT equipment), where the provider will be responsible for the scope 2 emissions from the energy acquired to power the ICT equipment.

2.3.2 Water cooling and consumption

Data centre cooling systems require significant amounts of water.[85] Cooling systems are essential to data centre operations as ICT equipment generates heat during operation and needs to be cooled for optimal performance.[86] It has been estimated that some data centre operators draw more than half their water from

80 World Business Council for Sustainable Development and World Resources Institute (eds), *The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard* (Rev ed, 2004) 25.

81 World Business Council for Sustainable Development and World Resources Institute (n 80) 25.

82 Mario Schmidt, Moritz Nill and Johannes Scholz, 'Determining the Scope 3 Emissions of Companies' (2022) 45 Chemical Engineering & Technology 1218, 1220.

83 Based on the table contained in Jack Cook and David Davies, 'Scope Emissions White Paper (Revision 1)' (European Data Centre Association 2023) https://www.eudca.org/scope-emissions-white-paper-resource accessed 5 May 2024.

84 Cook and Davies (n 83).

85 Li and others (n 9).

86 Leila Karimi and others, 'Water-Energy Tradeoffs in Data Centers: A Case Study in Hot-Arid Climates' (2022) 181 Resources, Conservation and Recycling 106194.

potable sources,[87] though hyperscalers in Europe are expanding their use of non-potable water.[88] The quality of water used is important for hygiene and maintenance of equipment, with chemical water treatment used to maintain water quality within the systems.[89] This discharged water has a far higher environmental impact than tap water, as it requires processing to remove metals including chlorine, iron and copper.[90]

Information regarding water consumption of data centres is closely guarded by all providers and there is less scholarly research on water consumption of data centres than electricity and energy efficiency.[91] Amazon, Microsoft and Google have made ambitious pledges to improve on water sustainability by reducing their consumption but also through water stewardship programmes that provide potable water to communities. Amazon has committed to being water positive by 2030, which it defines as 'AWS will return more water to communities than it uses in its direct operations.'[92] Microsoft has set the same goal.[93] Google has a similar goal, to replenish 120% of freshwater consumed on average across its offices and data centres by 2030.[94] Water stewardship programmes can operate similarly to carbon offsets: they compensate for the water consumed but do not necessarily replenish it in the areas from where it was used. Rather than reducing consumption, it promises compensation elsewhere.

The growing water consumption of data centres has received increased media attention. An extreme example was a Google data centre in Wallonia, Belgium, which made headlines with its record annual consumption of one million cubic metres of water, equivalent to the annual consumption of 10,700 households in the area. 30% of this water was released into a nearby river, while 70% evaporated.[95] Consumption of potable water in 'water stressed' regions has created considerable concern among local communities, as demonstrated by the reaction to Meta's most recent hyperscale data centre development in Talavera in Spain but it became equally a matter of concern in the Netherlands.[96]

2.3.3 Electronic waste

E-waste occurs in two key stages of the data centre lifecycle; the manufacturing of the ICT equipment used in data centres and in its disposal. Energy efficiency and performance of equipment, in particular servers, has improved rapidly in the past decade.[97] There is a trade-off between increasing 'refresh rates' of servers, to ensure the most high-performing equipment is being utilised, and the resource efficiency of producing, recycling and disposing of servers.[98] In addition, equipment is often underutilised for a number of reasons,

87 Mytton (n 8).
88 'Google to Expand Hamina Data Centre' *Helsinki Times* (3 August 2012) https://www.helsinkitimes.fi/finland/finland-news/domestic/3117-google-to-expand-hamina-data-centre.html accessed 12 July 2024.
89 Sophia Flucker, Robert Tozer and Beth Whitehead, 'Data Centre Sustainability – Beyond Energy Efficiency' (2018) 39 Building Services Engineering Research and Technology 173.
90 Flucker, Tozer and Whitehead (n 89).
91 Mytton (n 8).
92 '2023 Amazon Sustainability Report' (Amazon 2023) 6 https://sustainability.aboutamazon.com/2023-amazon-sustainability-report.pdf accessed 10 October 2024.
93 Microsoft, 'How Can We Advance Sustainability? 2024 Environmental Sustainability Report' (2024) 25 https://query.prod.cms.rt.microsoft.com/cms/api/am/binary/RW1lMjE accessed 10 October 2024.
94 'Google Environmental Report 2024' (Google 2024) 46 https://www.gstatic.com/gumdrop/sustainability/google-2024-environmental-report.pdf accessed 10 October 2024.
95 Lauren Walker, 'Google Data Centre in Belgium the Most "water-Hungry" in Europe' https://www.brusselstimes.com/616534/google-data-centre-in-belgium-the-most-water-hungry-in-europe accessed 22 May 2024.
96 Pablo Jiménez Arandia, 'De la Operación Tulipán a la Operación Zarza: así trasladó Meta su nuevo hipercentro de datos a la España vaciada' *El País* (21 March 2024) www.elpais.com/tecnologia/2024-03-21/de-la-operacion-tulipan-a-la-operacion-zarza-asi-traslado-meta-su-nuevo-hipercentro-de-datos-a-la-espana-vaciada.html# accessed 2 July 2024.
97 Javier Felipe Andreu, Alicia Valero Delgado and Jorge Torrubia Torralba, 'Big Data on a Dead Planet: The Digital Transition's Neglected Environmental Impacts' (The Left in the European Parliament 2022) https://left.eu/issues/big-data-on-a-dead-planet-the-digital-transitions-neglected-environmental-impacts/ accessed 22 July 2024.
98 Commission and others, *Development of the EU Green Public Procurement (GPP) Criteria for Data Centres, Server Rooms and Cloud Services – Final Technical Report* (Publications Office 2020) 63; Rabih Bashroush, 'A Comprehensive Reasoning Framework for Hardware Refresh in Data Centers' (2018) 3 IEEE Transactions on Sustainable Computing 209, 209.

such as clients requesting spare capacity.[99] The growth of AI workloads and the resulting results in the constant need for more powerful hardware, such as GPUs and other components.[100]

The manufacture and disposal of data centre ICT equipment comes with considerable pollution impacts. Manufacturing IT equipment requires key critical raw materials such as rare earth metals, Barium (Ba) and Gallium (GA), which come with associated environmental impacts.[101] During both manufacturing and disposal, dangerous chemicals for the environment and health, such as mercury and lead, are released into the surrounding environment.[102] According to the United Nations Global E-Waste Monitor, global generation of electronic waste is rising five times faster than documented e-waste recycling.[103] Of key concern is that much of Europe's e-waste is not processed and recycled in Europe but exported to developing countries, which have less stringent regulations.[104] However, as will be discussed below, more circular economy approaches are being included in more recent regulation.

In conclusion, from the growing recognition of increased electricity consumption and GHG emissions and distribution of renewable energy sources, to the understanding of water consumption and generation of electronic waste, data centres present a number of different but significant and sometimes competing sustainability considerations. EU law and policy relevant to data centres' sustainability are starting to catch up, as will be shown in the next section.

3. EU law and policy on data centres

This section provides an overview of the growing body of EU law and policy addressing sustainability issues of data centres. It first addresses the question of EU competence and policy objectives in this space, before outlining the relevant rules on energy efficiency, electronic equipment and waste, as well as the transparency and reporting obligations pertaining to data centre operators, cloud service providers and customers. The aim is to provide the reader with a clear overview of the legal framework, before analysing potential gaps and limitations in Section 4.

3.1 EU competence in energy and the environment

The EU's legislative competences are governed by the principle of conferral, which provides that the Union may only act within the competences conferred upon it by the Member States in the Treaties.[105] The EU has shared competence in two key policies areas which affect data centre law and policy: energy and environment. 'Shared' competence means that subject to the EU law principles of proportionality and subsidiarity, the EU can exercise its competence and where the EU adopts secondary legislation, it takes precedence over Member States' national law.[106]

The Treaty of Maastricht made the environment an official EU policy area,[107] with the Lisbon Treaty making 'combatting climate change' a specific goal of the EU.[108] Art. 11 of the Treaty on the Functioning of the European Union (TFEU) provides that environmental protection and sustainable development requirements

99 Felipe Andreu, Valero Delgado and Torrubia Torralba (n 97) 17.
100 Alessia Zhuk, 'Artificial Intelligence Impact on the Environment: Hidden Ecological Costs and Ethical-Legal Issues' (2023) 1 Journal of Digital Technologies and Law 932, 940.
101 Commission and others, (n 98) 64.
102 Commission and others, (n 98) 65.
103 Cornelis P Baldé and others, 'The Global E-Waste Monitor 2024' (International Telecommunication Union (ITU) and United Nations Institute for Training and Research (UNITAR) 2024) 10, 16 https://ewastemonitor.info/the-global-e-waste-monitor-2024/ accessed 10 September 2024.
104 Commission and others (n 98) 64; Baldé and others (n 103) 40.
105 Consolidated version of the Treaty on European Union, OJ 2012 C326/13 (TEU), art 5(2).
106 TEU arts 4, 5(3),(4).
107 Christoph Knill and others, 'The Establishment of EU Environmental Policy', *Environmental Policy in the EU: Actors, Institutions and Processes* (4 edn, Routledge 2021) 40.
108 Treaty of Lisbon amending the Treaty on European Union and the Treaty establishing the European Community, OJ 2007 C306/1, art 143(a).

must be integrated into the formulation and implementation of the Union's policies and activities.[109] Equally, policy should aim at a high level of protection and be based on the precautionary principle and the principles that preventative action should be taken, that environmental damage should as a priority be rectified at the sources and that the polluter should pay.[110]

In relation to energy, the EU has competence in the context both of the environment and the establishment and functioning of the single market.[111] Union policy aims to ensure the functioning and security of the energy market, promote energy efficiency, energy saving and development of new and renewable forms of energy.[112] Through its competences in both environment and energy, the EU also exerts some impact over spatial planning and construction, despite having no formal competence.[113] In addition, the EU has some competence for water policy[114] and waste within the context of the environment policy.[115]

3.2 EU sustainability policy relating to data centres

Data centres come within the scope of several EU legal instruments. In the European Green Deal, the Commission set the goal to achieve climate neutrality by 2050 and a reduction of GHG emissions by 55% compared to 1990 levels.[116] This was later made a legally binding commitment in the EU Climate Law.[117] In addition, in the Renewable Energy Directive (RED), the EU set a target of increasing the share of energy from renewable energy sources to 42.5% until 2030.[118]

With data centres, the key policy goal of a 'twin transition of digitalisation and decarbonisation' comes together.[119] The Commission has set the specific goal of achieving 'climate-neutral, highly energy-efficient and sustainable data centres by no later than 2030.'[120] In particular, the recent European Declaration on Digital Rights and Principles for the Digital Decade, though non-binding, shows that the environmental risks of digital products and services are being increasingly recognised at the EU level.[121]

3.3 EU legal framework

The following sections provide an overview of the relevant EU law relating to data centres' sustainability, including energy efficiency and sustainability of operations, operation of data centre equipment and reporting and transparency obligations.

3.3.1 Energy efficiency and sustainability of data centre operations

This section outlines the EU instruments which currently govern energy efficiency and sustainability of data centres' operations.

109 Consolidated version of the Treaty on the Functioning of the European Union, OJ 2012 C 326/47 (TFEU) art 11.
110 TFEU art 191(2).
111 TFEU art 194(1).
112 TFEU art 194(1).
113 Committee of the Regions and others, *Spatial Planning and Governance within EU Policies and Legislation and Their Relevance to the New Urban Agenda* (European Committee of the Regions 2018) 3 https://data.europa.eu/doi/10.2863/0251 accessed 2 February 2024.
114 TFEU arts 191-193.
115 TFEU arts 192(1).
116 Commission (n 12) 4.
117 European Climate Law arts 2, 5.
118 Directive 2023/2413 of the European Parliament and of the Council of 18 October 2023 amending Directive (EU) 2018/2001, Regulation (EU) 2018/1999 and Directive 98/70/EC as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652, OJ 2023 L 2023/2413 (RED 2023) art 1(2)(a).
119 Commission (n 11).
120 Commission (n 13) 13.
121 European Declaration on Digital Rights and Principles for the Digital Decade, OJ 2023 C 23/1 Chapter VI; Victorio, Celeste and Quintavalla (n 26).

Energy Efficiency Directive (Recast)

The revised Energy Efficiency Directive (EED) entered into force on 10 October 2023.[122] Member States must adopt national law by 11 October 2025 that brings into force the majority of the EED's provisions.[123] As this is a minimum harmonisation directive, Member States may adopt stricter thresholds in their national laws, where permitted in the text.[124]

The EED contains a number of general obligations that are applicable to data centres as defined in Art 2(49).[125] The 'energy efficiency first' principle requires that Member States must assess energy efficiency solutions in any planning, policy and major investment decisions of more than €100 million, including ICT infrastructure.[126] This obligation must be implemented by October 2025.[127] Hyperscale data centres can far surpass this limit, for example, a new data centre planned by Google in the Netherlands is estimated to cost €600 million.[128] Art 11(1) EED introduces an obligation for enterprises with an annual average consumption greater than 85 TJ (approximately 23,611 MWh) over the previous three years to implement an energy management scheme by 11 October 2027.[129] This would include the higher end of 'midsize' data centre range within this scope. Enterprises with an energy demand under 85 TJ but over 10 TJ (2778 MWh) do not have to implement an energy management scheme but will be required to carry out an energy audit by 11 October 2026, then at least every four years.[130]

Specifically regarding data centres, Art 12(4) EED provides that Member States are to 'encourage' owners and operators of data centres with a power demand of installed IT of at least 1MW to 'take into account' the best practices in the most recent version of the European Code of Conduct for Energy Efficiency in Data Centres (The European Code of Conduct).[131] By 15 May 2025, the Commission must assess available data reported in accordance with Art 12(1) EED on energy efficiency of data centres and submit a report to the European Parliament and Council (see below in section regarding reporting).[132] Moreover, Article 26 EED requires Member States to ensure data centres with an energy input exceeding 1 MW utilise waste heat or other recovery applications, unless they can prove it is not technically or economically feasible.[133]

Renewable Energy Directive

The Renewable Energy Directive (RED) entered into force on 20 November 2023.[134] With a few exceptions, Member States were required to bring its provisions into force by 1 July 2024.[135] The RED impacts the development of new data centres, as it introduces the Union's target of at least 49% of energy from renewable sources in the final energy consumption of buildings in 2030.[136] The Directive also includes new provisions to streamline the permit granting procedure to build, repower and operate renewable energy

122 EED art 39.

123 EED art 36.

124 Sebastiaan Princen and others, 'Flexible Implementation and the Energy Efficiency Directive' (European University Institute 2022) Working Paper 13 https://cadmus.eui.eu/handle/1814/74413 accessed 14 June 2024.

125 EED art 2(49) refers to the definition of data centre in Annex A, point 2.6.3.1.16, of Regulation (EC) No 1099/2008 which was quoted above in section 2.1.

126 EED art 3(1)(b).

127 EED, art 36(1).

128 Hana Anandira, 'Google to Invest €600M in Dutch Data Centre' (*Mobile World Live*, 23 April 2024) https://www.mobileworldlive.com/europe/google-to-invest-e600m-in-dutch-data-centre/ accessed 10 October 2024.

129 EED art 11.

130 EED art 11(2); Member States have the ability to require such audits to be carried out more regularly.

131 EED art 12(3). The European Code of Conduct is voluntary initiative set up by the Joint Research Centre that encourages and guides data centre operators and owners to reduce energy consumption within data centres and raise awareness of energy efficient best practices. European Commission, 'European Code of Conduct for Energy Efficiency in Data Centres - European Commission' https://joint-research-centre.ec.europa.eu/scientific-activities-z/energy-efficiency/energy-efficiency-products/code-conduct-ict/european-code-conduct-energy-efficiency-data-centres_en accessed 26 January 2025.

132 EED art 12(4).

133 EED art 26(6).

134 RED 2023 art 5.

135 RED 2023 art 5.

136 Art 15a(1) Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (recast), OJ 2018 L 328 (RED 2018), as amended by RED 2023 art 1(6).

plants, including heat pumps, and integration of renewable energy into heating and cooling networks.[137] This is further supported by the Council Regulation laying down a framework to accelerate the deployment of renewable energy.[138] This will be relevant to data centre operators such as Amazon who have built their own renewable energy sources in Europe, such as rooftop solar installations, wind and solar farms.[139] The RED also includes an obligation on Member States to require the use of minimum levels of energy from renewable energy sources produced on-site or nearby in new buildings and existing buildings undergoing renovation.[140] Member States have until 21 May 2025 to bring this into force.

Similarly to the EED, regarding data centres, the RED focuses on the use of heat pump technology to mobilise waste heat from data centres as a source of renewable energy.[141] Art 24(6)(b) RED obliges Member States to put in place a coordination framework between district heating and cooling system operators and sources of waste heat from data centres.[142] Member States must bring this obligation into force by 21 May 2025. A Commission Delegated Regulation specifies the methodology for calculating the share of renewable energy in cooling.[143]

EU Taxonomy Regulation and relevant Delegated Acts

The EU Taxonomy Regulation (the Taxonomy) entered into force on 12 July 2020 and as an EU regulation it is directly applicable law in the Member States.[144] The Taxonomy provides a unified classification system allowing investors and companies to identify and channel funding to sustainable activities that align with the objectives of the EU Green Deal. The six objectives are climate change mitigation, climate change adaption, the sustainable use and protection of water and marine resources, the transition to circular economy, pollution prevention and control, and the protection and restoration of biodiversity and ecosystems.[145]

Designation of an economic activity as 'Taxonomy aligned' means the activity substantially contributes to at least one of the six objectives of the Green Deal, while doing no significant harm to the other objectives.[146] Companies are not required to have Taxonomy aligned activities but if they fall under the scope of the Corporate Sustainable Reporting Directive (CSRD) they will be required to disclose to financial markets whether they have any Taxonomy aligned activities.[147] Therefore, disclosure of an economic activity as 'Taxonomy aligned' would place companies in a better position to attract investors interested in green investments.[148] Data centres may be eligible for qualification as an sustainable activity contributing to two of the six categories: climate change mitigation and the transition to circular economy.[149]

137 RED 2018 arts 16a-3, as amended by RED 2023 art 1(7).

138 Council Regulation (EU) of 22 December 2022 laying down a framework to accelerate the deployment of renewable energy 2022/2577, OJ 2022 L 335/36

139 'Amazon Adds 39 Renewable Energy Projects in Europe' (*EU About Amazon*, 22 October 2023) https://www.aboutamazon.eu/news/sustainability/amazon-adds-39-renewable-energy-projects-in-europe accessed 15 August 2024.

140 RED 2018 art 15(a)(3) as amended by RED 2023 art 1(6).

141 RED 2023 recital 43.

142 RED 2018 art 24(6)(b) as amended by RED art 1(14).

143 Commission Delegated Regulation (EU) 2022/759 of 14 December 2021 regards a methodology for calculating the amount of renewable energy used for cooling and district cooling, OJ 2022 L 139/1.

144 Regulation 2020/852 of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088 (EU Taxonomy Regulation), OJ 2022 L198/13.

145 EU Taxonomy Regulation art 9.

146 EU Taxonomy Regulation art 3.

147 EU Taxonomy Regulation art 1(c).

148 Commission, 'FAQ: What Is the EU Taxonomy and How Will It Work in Practice?' (*finance.ec.europa.eu*) https://finance.ec.europa.eu/document/download/a3c5fc94-6bc8-4c65-bc6c-de37cf3848b0_en?filename=sustainable-finance-taxonomy-faq_en.pdf accessed 15 August 2024.

149 Commission Delegated Regulation C/2021/2800 of 4 June 2021 supplementing Regulation (EU) 2020/852 of the European Parliament and of the Council by establishing the technical screening criteria for determining the conditions under which an economic activity qualifies as contributing substantially to climate change mitigation or climate change adaptation and for determining whether that economic activity causes no significant harm to any of the other environmental objectives (Climate Delegated Act), OJ 2021 L 442, Annex I, 179.

The criteria for qualification as an activity that contributes to climate change mitigation were set down in the EU Taxonomy Climate Delegated Act, which entered into force on 1 January 2022.[150] The preamble notes that the ICT sector's contributions to GHG emissions are growing, while acknowledging the potential that digital technologies have to provide solutions to reduce emissions.[151] To balance the need for ICT while mitigating its high GHG emissions, data centres may qualify as a Taxonomy aligned activity under Activity 8.1 'Data processing, hosting and related activities'.[152] Data centres must then meet the technical screening criteria, while demonstrating they cause no significant harm to the other five objectives.[153]

The technical screening criteria include adherence to the 'expected practices' in the most recent version of the European Code of Conduct or the CEN-CENELEC document CLC TR50600-99-1 'Data centre facilities and infrastructures - Part 99-1: Recommended practices for energy management'.[154] Where an expected practice is not considered relevant for a particular reason, alternative practices from the European Code of Conduct or equivalent sources may be identified as best practices, if they result in similar energy savings.[155] Finally, the global warming potential (GWP) of refrigerants used in the data centre cooling systems must not exceed 675 GWP.[156] These must be verified and audited by an independent third party every three years.[157]

Of particular interest for Activity 8.1 is the 'do no significant harm criteria' for the objective 'transition to circular economy'.[158] This requires that the equipment meets the requirements set down in the Ecodesign Regulation for servers and data storage products (detailed below) and that the equipment does not contain restricted substances. Equally a waste management system must be in place to ensure maximal recycling of end of life electrical and electronic equipment, in accordance with the WEEE Directive (discussed below).

The criteria for qualification as an activity that contributes substantially to the transition to circular economy were set down in the EU Taxonomy Environmental Delegated Act, which entered into force on 1 January 2024. Data centres are mentioned in relation to Activity 5.6 'Marketplace for the trade of second-hand goods for reuse', which covers computer and electronic products, electrical equipment and non-domestic heating and cooling ventilation equipment.[159] The technical screening criteria specifically reference marketplaces or classifieds supporting the sale or reuse of servers and data storage products and generally require the same criteria previously set out in Activity 8.1 of Climate Delegated Disclosures Act above. For example, the 'do no significant harm to climate change are the same.[160] One key difference is that Activity 5.6 does specify criteria for the objective 'pollution prevention and control' including use of specific substances such as mercury and its compounds. [161] This means that unlike the criteria for Activity 8.1, Activity 5.6 more comprehensively addresses the potential for data centres to contribute to pollution.

EU Green Public Procurement criteria

The EU Green Public Procurement (GPP) criteria for data centres, server rooms and cloud services are voluntary criteria, also produced by the Commission's Joint Research Centre (JRC), providing public

150 Climate Delegated Act Annex I, 179; Commission Delegated Regulation 2023/2486 of 27 June 2023 supplementing Regulation (EU) 2020/852 of the European Parliament and of the Council by establishing the technical screening criteria for determining the conditions under which an economic activity qualifies as contributing substantially to the sustainable use and protection of water and marine resources, to the transition to a circular economy, to pollution prevention and control, or to the protection and restoration of biodiversity and ecosystems and for determining whether that economic activity causes no significant harm to any of the other environmental objectives and amending Commission Delegated Regulation (EU) 2021/2178 as regards specific public disclosures for those economic activities (Environmental Delegated Act), OJ 2023 L 2486.

151 Climate Delegated Act recital 38.

152 Climate Delegated Act Annex I, 132.

153 Climate Delegated Act Annex I, 132.

154 Climate Delegated Act Annex I, 133.

155 Climate Delegated Act Annex I, 133

156 Climate Delegated Act Annex I, 133.

157 Climate Delegated Act Annex I, 133.

158 Climate Delegated Act Annex I, 135.

159 Environmental Delegated Act, Annex IV, 81.

160 Environmental Delegated Act 82.

161 Environmental Delegated Act, Annex IV, Appendix C, 97.

authorities with guidance on purchasing products and services with a reduced environmental impact.[162] The EU GPP also refer to the European Code of Conduct and standards set by European Committee for Standardisation (CEN), the European Committee for Electrotechnical Standardisation (CENELEC) and the European Telecommunications Standards Institute (ETSI), collectively known as CEN/CENELEC/ETSI.

European Code of Conduct and CEN/CENELEC/ETSI CG-GDC

There are two sets of non-binding standards which wield a certain authority through their incorporation in the earlier mentioned EED, Taxonomy and the EU GPP criteria.

The European Code of Conduct is a voluntary initiative of the JRC, which sets some minimum standards and collects best practices on data centre utilisation, management and planning. These are outlined in annual Best Practices documents.[163] The European Code of Conduct underwent a revision in 2022 to include non-energy related environmental indicators, such as water consumption, share of renewable energy use and share of energy reuse.[164] The JRC published an Assessment Framework for Data Centres in the context of activities in the Taxonomy Climate Delegated Act, which allows auditors to more easily verify if the European Code of Conduct practices are applied.[165]

The second key set of standards are created by the CEN/CENELEC/ETSI, in consultation with stakeholders of industry and EU projects,[166] in particular concerning data centre energy management and environmental sustainability, with some being included in the above discussed legislation.[167] The most referenced standard is the CEN-CENELEC document CLC TR50600-99-1 'Data centre facilities and infrastructures – Part 99-1: Recommended practices for energy management,' included in the EU Taxonomy Regulation[168] and the EU GPP.[169] In the EED, the CEN/CENELEC EN 50600-400 'Information Technology – Data Centre Facilities and infrastructures' are included in minimum requirements for Member States to publish the energy performance of data centres.[170]

3.3.2 Data centre equipment: use and disposal

This section will outline the EU regulations regarding the use and disposal of data centre equipment for servers and data storage.

Ecodesign Regulation

The Ecodesign Regulation for servers and data storage products[171] (the Ecodesign Regulation) was adopted pursuant to the Ecodesign Directive,[172] by the Commission on 15 March 2019 and entered into force in April 2019.[173] The aim of the Ecodesign Regulation is to decrease energy usage of data centres and was based

162 Commission, 'EU green public procurement criteria for data centres, server rooms and cloud services' SWD(2020) 55 final.

163 Commission and others, '2024 Best Practice Guidelines for the EU Code of Conduct on Data Centre Energy Efficiency' (European Commission, Ispra 2024) https://e3p.jrc.ec.europa.eu/sites/default/files/documents/publications/jrc136986_2024_best_practice_guidelines.pdf accessed 10 September 2024.

164 Commission, 'Digitalising The Energy System - Eu Action Plan' SWD (2022) 341, 46-47.

165 Paolo Bertoldi, 'Assessment Framework for Data Centres in the Context in the Taxonomy Climate Delegated Act' (2023) JRC131733 https://e3p.jrc.ec.europa.eu/publications/assessment-framework-data-centres-context-activity-81-taxonomy-climate-delegated-act accessed 17 October 2024.

166 Some examples of EU projects include the EU Fit4Green and GAMES projects, 'CEN/CLC/ETSI Joint Coordination Group Green Data Centres (n 33) 42.

167 For a broader overview of existing standards on data centre energy management and environmental sustainability, please see CEN/CENELEC/ETSI Coordination Group on Green Data Centres, 'Review of Standardisation Activities Energy Management and Environmental Viability of Data Centres Based on the Edition 10 Report of the CEN/CENELEC/ETSI Coordination Group on Green Data Centres' (2023) https://www.cencenelec.eu/media/CEN-CENELEC/AreasOfWork/CEN%20sectors/Digital%20Society/Green%20Data%20Centres/brochuredatacentrestandardizationedition10_2023.pdf accessed 7 May 2024.

168 Climate Delegated Act Annex I 133; Environmental Delegated Act Annex IV, 81-82.

169 Commission (n 162) 10, 17, 18, 30.

170 EED, Annex VII.

171 Commission Regulation (EU) 2019/424 of 15 March 2019 laying down ecodesign requirements for servers and data storage products pursuant to Directive 20019 125/EC of the European Parliament and of the Council and amending Commission Regulation (EU) No 617/2013 (Ecodesign Regulation), OJ 2019 L 74/46

172 Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products (recast), OJ 2009 L 285/10.

173 Ecodesign Regulation art 10.

on a preparatory study that showed improvements in the material efficiency of servers and data storage could contribute to a 30% reduction in energy consumption.[174] Equally, the Commission noted a specific aim of the policy was to raise awareness regarding and facilitate comparison between products for users.[175] The Annexes to the Regulation include the specific design requirements for servers, including minimum efficiency and power requirements.[176]

The Ecodesign Directive has been replaced by the Ecodesign for Sustainable Products Regulation (ESPR) which entered into force on 18 July 2024.[177] Currently, there are no specific requirements relating to data centre equipment, meaning the 2019 Regulation for servers and data storage products remains the applicable law to data centre equipment.

WEEE Directive

The Waste Electrical and Electronic Equipment (WEEE) Directive entered into force on 13 August 2012[178] and was most recently amended in 2018.[179] The Directive aims to contribute to sustainable production and consumption, to reduce waste of electric and electronic equipment (EEE), to contribute to efficient use of resources, retrieval of valuable secondary materials and improve the environmental performance of all operators directly involved in collection and treatment of WEEE.[180] The equipment used in data centres is categorised, depending on size, as either Category 4 (large equipment) or Category 6 (Small IT and Telecommunications equipment).[181]

The WEEE Directive distinguishes between three actors: producers, distributors and users of EEE.[182] Operators of co-hosting, hosting and hybrid data centres could be considered both users and distributors of EEE simultaneously, as they both purchase data storage equipment and lease it to their clients. As a distributor, data centre operators may be required by the Member State in which they are established to provide for the collection of WEEE.[183] Equally they may be required to provide the necessary information to facilitate separate collection of WEEE.[184] There are no specific requirements for users stipulated in the WEEE Directive, however, as the focus is on preventing pollution and facilitation of separate and safe collection, any negligence in this regard could attract other forms of liability, depending on the Member State.

3.3.3 Transparency and reporting obligations relevant to data centre operation and use

This section provides an overview of the reporting obligations introduced at the EU level applicable to data centres operators, which aims to improve transparency regarding data centres' usage of electricity and natural resources.

174 Commission and others, 'Ecodesign Preparatory Study on Enterprise Servers and Data Equipment' (n 28).

175 Commission, 'Impact Assessment accompanying the document Commission Regulation laying down ecodesign requirements for servers and data storage products pursuant to Directive 2009/125/EC/ of the European Parliament and Council and amending Commission Regulation (EU) 617/2013 SWD/2019/0106 final, 34.

176 Ecodesign Regulation Annex II.

177 Commission, 'Ecodesign for Sustainable Products Regulation' https://commission.europa.eu/energy-climate-change-environment/standards-tools-and-labels/products-labelling-rules-and-requirements/sustainable-products/ecodesign-sustainable-products-regulation_en accessed 2 July 2024.

178 Directive 2012/19/EU of the European Parliament and Council of 4 July 2012 on waste electrical and electronic equipment (recast), OJ 2012 L197/38

179 Directive (EU) 2018/849 of the European Parliament and of the Council of 30 May 2018 amending Directives 2000/53/EC on end-of-life vehicles, 2006/66/EC on batteries and accumulators and waste batteries and accumulators, and 2012/19/EU on waste electrical and electronic equipment, (WEEE Directive), OJ 2018 L 150/9

180 WEEE Directive, recital (6).

181 WEEE Directive, Annex IV.

182 WEEE Directive, arts 3(f)-(g), A 'producer' is a legal entity established in a Member State who designs, manufactures, markets or resells EEE on the market of a Member State. Distributors are defined as those in the supply chain who make EEE available on the market, by supplying a product for distribution, consumption or use on the market of a Member State in the course of a commercial activity. Users are not defined but can be considered as consumers of EEE.

183 WEEE Directive art 5(5).

184 WEEE Directive art 14(5).

EED and the Commission Delegated Regulation on the first phase of the establishment of a common Union rating scheme for data centres

In addition to obligations regarding improving energy efficiency, the EED also introduces reporting obligations, which aim to facilitate information gathering for a common Union rating system for data centres.[185] Art 12 EED provides that by 15 May 2024 and then annually, Member States must require owners and operators of data centres with a power demand of installed IT of at least 500 kW to disclose information contained in Annex VII of the Directive[186] (excluding those providing services exclusively with the final aim of defence and civil protection).[187]

Pursuant to Art 12 EED, the Commission Delegated Regulation on the first phase of the establishment of a common Union rating scheme for data centres (Commission Delegated Regulation) was adopted on 14 March 2024 and entered into force on 6 June 2024.[188] The Delegated Regulation includes a number of key performance indicators (KPIs) that data centres must report by 15 September 2024, then 15 May 2025 and annually thereafter to their national reporting scheme, if one already exists, or directly to the European database.[189]

The four Annexes of the Delegated Regulation contain detailed reporting obligations. Annex I includes the basic information, such as name, type of data centre and location. Annex II contains the KPIs to be monitored, including energy and sustainability indicators, such as energy consumption, power utilisation, water input and waste heat reused, measurement of waste heat temperature, ICT capacity indicators and data traffic indicators. Annex III includes the calculation methodologies for the sustainability indicators. Annex IV requires certain aggregate information to be made available in the database, including total energy consumption for all reporting data centres in the member state's territory.

In addition to requiring information on energy consumption to be made available, both the EED and Commission Delegated Regulation emphasise the need to collect data on the water footprint of data centres.[190] The KPIs included in the Delegated Regulation include information on water consumption, including total water input,[191] total potable water input,[192] and water usage effectiveness.[193] This will allow publication of the total water consumption of all reporting data centres at the member state and Union level in the database.[194] The Commission will build a database from this information with aggregated data that will be made public.[195]

Medium Combustion Plants Directive and Industrial Emissions Directive

The Medium Combustion Plants Directive[196] entered into force on 18 December 2015 with Member States required to bring these obligations into force by 19 December 2017. It aims to control emissions into the air from combustion plants, such as backup diesel generators, with a total thermal input between 1-50 MW.[197] It introduces a permits system whereby member states must require medium combustion plants with a rated thermal input greater than 5 MW to operate with a permit or be registered.[198] By 2029, this will also apply to plants with a rated thermal input of less than or equal to 5MW.[199]

185 Commission (n 164) 50.
186 EED art 12(1).
187 EED Art 12(2).
188 Commission Delegated Regulation 2024/1364 of 14 March 2024 on the first phase of the establishment of a common Union rating scheme for data centres (Common Union Data Centre Rating Scheme Regulation) OJ 2024 L 2024/1639.
189 ibid, Art 3(1).
190 EED, Recital 85, 87; Common Union Data Centre Rating Scheme Regulation Recital 11.
191 Common Union Data Centre Rating Scheme Regulation Annex II, 1(f).
192 Common Union Data Centre Rating Scheme Regulation Annex II, 1(i).
193 Common Union Data Centre Rating Scheme Regulation Annex III (b).
194 Common Union Data Centre Rating Scheme Regulation Annex IV.
195 EED Art 12(3).
196 Directive 2015/2193 of the European Parliament and of the Council of 25 November 2015 on the limitation of emissions of certain pollutants into the air from medium combustion plants (Medium Combustion Plants Directive), OJ 2015 L 313/1.
197 Medium Combustion Plants Directive arts 1 and 2.
198 Medium Combustion Plants Directive art 5(2).
199 Medium Combustion Plants Directive art 5(2).

In addition to the permits system, Member States were required to gather qualitative and qualitative information[200] on the total emissions from medium combustion plants by 1 January 2021, used by the Commission to provide a summary report to the Parliament and Council.[201] Member States must also by 1 October 2026 and 1 October 2031 submit a report with the required information and measures taken to implement and enforce the Directive.[202] Therefore, Member States have an obligation to ensure data centres using a diesel generator must report it or operate with a permit. The Member States have discretion on how to gather and make public the information: for example, in Ireland there is a publicly accessible register.[203] Recent grid capacity issues in Ireland have led to more applications for diesel generators by data centre operators, which suggests diesel generators are not just being used as backup but to meet increased energy demands.

The Industrial Emissions Directive as amended[204] entered into force on 26 January 2011 and applies to combustion plants with a total thermal input of over 50 MW.[205] Similar to the Medium Combustion Plants Directive it also introduces a permits system[206] and through the Industrial Emissions Portal Regulation[207] will require industrial operators to report on significant emissions and use of resources. The Portal will apply from 1 January 2028 and include information on individual installations and present data in both aggregated and non-aggregated forms.[208]

EU Taxonomy Regulation, Corporate Sustainable Reporting Directive and Corporate Sustainability Due Diligence Directive

In addition to providing a framework for sustainable investment, the EU Taxonomy Regulation and the Corporate Sustainable Reporting Directive (CSRD) introduce reporting obligations for undertakings operating data centres. Undertakings who are subject to the disclosure obligations contained in the Non-Financial Disclosures Directive (NFDD)[209] as amended by the CSRD[210] (discussed below) will have to disclose the proportion of its turnover and capital and operating expenditure (CapEx and OpEx) derived from sustainable activities.[211] The aim is to allow investors and the public to gain a better understanding of the undertaking's performance on sustainability matters. For example, a data centre operator would have to calculate and publish the percentage of its activities that derive from sustainable data hosting and storage activities or contribution to a marketplace for second-hand EEE. Undertakings not subject to the CSRD may also disclose this information but on a voluntary basis.

The CSRD entered into force on 5 January 2023, with Member States were required to bring into effect Arts 1 to 3 by 6 July 2024.[212] It complements the EU Taxonomy in two ways; firstly, it amends the NFDD to expand the scope of the CSRD to all large companies and listed companies and to certain third country undertakings

200 Medium Combustion Plants Directive Annex I.
201 Medium Combustion Plants Directive art 11(2).
202 Medium Combustion Plants Directive art 11(1).
203 Irish Environmental Protection Agency, 'Medium Combustion Plant Registration MCP Register https://www.epa.ie/mcp/#/register accessed 10 October 2024.
204 Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) OJ L 334, as amended by Directive (EU) 2024/1785 of the European Parliament and of the Council of 24 April 2024 amending Directive 2010/75/EU of the European Parliament and of the Council on industrial emissions (integrated pollution prevention and control) and Council Directive 1999/31/EC on the landfill of waste (Industrial Emissions Directive) OJ L 2024/1785.
205 Industrial Emissions Directive art 28.
206 Industrial Emissions Directive art 4.
207 Regulation 2024/1244 of the European Parliament and of the Council of 24 April 2024 on reporting of environmental data from industrial installations, establishing an Industrial Emissions Portal and repealing Regulation (EC) No 166/2006 (Industrial Emissions Portal Regulation) OJ L2024/1244.
208 Industrial Emissions Portal Regulation art 5.
209 Directive 2014/95/EU of the European Parliament and of the Council of 22 October 2014 amending Directive 2013/34/EU as regards disclosure of non-financial and diversity information by certain large undertakings and groups (NFDD), OJ 2014 L 330/1.
210 Directive 2022/2464 of the European Parliament and of the Council of 14 December 2022 amending Regulation (EU) No 537/2014, Directive 2004/109/EC, Directive 2006/43/EC and Directive 2013/34/EU, as regards corporate sustainability reporting (CSRD), OJ 2022 L 322/15.
211 NFDD arts 19a and 29a, as amended by CSRD art1(4) and (7).
212 CSRD art 5.

which have a substantial presence in the Union.[213] Over time, more companies will come under the scope of the CSRD, including small and medium size enterprises. There are different reporting deadlines for the different types of companies. As the majority of the data centre market is made up of third country undertaking, the key date reporting deadline is 2028, covering the 2027 financial year, however, depending on the type of information to be disclosed, there may be further phase in options.[214] This means it will be some time before a third country data centre operator will be required to fully disclose all sustainability information contained in the CSRD.

Secondly, in addition to the EU Taxonomy requirement of disclosure of the proportion of turnover, CapEx and OpEx related to sustainable activities, the CSRD requires disclosure of more qualitative information in a publicly accessible sustainability statement.[215] Data centre operators coming within its scope must carry out a double materiality assessment of all activities in its value chain, including their impacts, risks and opportunities on the environment (impact materiality) as well as sustainability matters that financially impact the undertaking (financial materiality).[216] They must then assess these activities in accordance with the five European Sustainability Reporting Standards (ESRS) related to the environment, as adopted in the Commission Delegated Regulation regarding Sustainable Reporting Standards.[217] These include climate change, pollution, water and marine resources, biodiversity and ecosystems and resource use and circular economy.

In addition, a number of disclosure requirements are relevant to data centre operations. ESRS E1 provides the disclosure requirements related to climate change and provides that companies must disclose their gross Scope 1, 2 and 3 GHG emissions.[218] Interestingly, the standards provide that, where material, an undertaking shall disclose the GHG emissions from purchased cloud computing and data centres services as a subset of overarching Scope 3 category 'upstream purchased goods and services.'[219] This means not only will the data centre operator have to disclose its GHG emissions but equally the data centre's customers. The ESRS also provide the undertaking will have to disclose pollution and water and marine related polices and actions and resources. [220] In particular, there is a specific obligation to disclose information on its water consumption performance.[221] Data centre operators will have to disclose information on its total amount of waste, including electronic waste.[222]

The recently adopted Corporate Sustainability Due Diligence Directive (CSDDD) entered into force on 25 July 2024, with Member States were required to transpose its provisions by 26 July 2026.[223] The CSDDD complements the CSRD by introducing obligations on companies to take responsibility for reducing and mitigating actual and potential human rights and environmental impacts with respect to their own operations and their subsidiaries and operations of their business partners.[224] It also introduces liability for violations of these obligations (though restricted),[225] as well as an obligation to adopt and put into effect a transition plan for climate change mitigation.[226] This aims to ensure compatibility of the business model and strategy to transition to a sustainable economy with the limiting of global warming to 1,5 degrees C.[227]

213 CSRD art 1(3) and (4).
214 CSRD art 5.
215 CSRD art 4.
216 CSRD art 1(4).
217 Commission Delegated Regulation 2023/2772 of 31 July 2023 supplementing Directive 2013/34/EU of the European Parliament and of the Council as regards sustainability reporting standards (ESRS), OJ 2023 L 2023/2772.
218 ESRS E1 Disclosure E1-6.
219 ESRS E1 Annex A, AR 48 and AR 51.
220 ESRS Disclosures E2-4 and E3-4.
221 ESRS E3 Disclosure E3-4.
222 ESRS E5 Disclosure E5-5, [37].
223 Directive 2024/1760 of the European Parliament and the Council of 13 June 2024 on corporate sustainability due diligence and amending Directive (EU) 2019/1937 and Regulation (EU) 2023/2859 (CSDDD), OJ 2024 L 2024/1760 art 38.
224 CSDDD arts 7-16.
225 CSDDD art 27, 29.
226 CSDDD art 22.
227 CSDDD art 22.

The CSDDD will apply to companies or parent companies of groups with more than 1000 employees and a net worldwide turnover of €450 million.[228] This means the CSDDD does not apply to all companies that come within the CSRD. It will also apply to third country companies or parent companies who generate the same turnover or who enter into or are the parent company of a group that enters into franchising or licencing agreements in the EU in return for royalties with independent third party companies.[229] Member States must designate supervisory authorities to supervise compliance[230] and must lay down rules on penalties for infringements of the national law adopted pursuant the CSDDD.[231] These measures will begin to apply in stages from 2027 until 2029.[232]

Artificial Intelligence Act

The landmark EU AI Act was adopted on 13 June 2024 and will generally enter into force on 2 August 2026, though a number of chapters will apply at different times.[233] While the AI Act does not specifically mention data centres, Art 51 and Annex XIII provides the conditions for classification by the Commission of general-purpose AI models as having 'systemic risk', with the Commission required to take into account the energy consumption of training the AI model. Art 95 also provides that the newly formed AI Office and Member States shall facilitate the drawing up of voluntary codes of conduct assessing and minimising the impact of AI systems on environmental sustainability, including energy efficient programming.[234]

Greenwashing and Green Claims Directives

The Greenwashing Directive entered into force on 26 March 2024.[235] Member States have until 27 March 2026 to bring these obligations into force and must apply the measures from 27 September 2026.[236] It amends the Unfair Commercial Practices Directive (UCPD)[237] and aims to combat misleading environmental claims, ensuring claims made by companies are fair, understandable and reliable.[238] It provides that a company, such as a data centre operator, cannot make a generic environmental claim without sufficient proof. This means the operator will have to support the environmental claim with clear, objective, publicly available and verifiable commitments set out in a publicly available implementation plan.[239] This plan must include measurable and time-bound targets and be regularly verified by an independent third party, otherwise the environmental claim will be regarded as a misleading commercial practice.[240] 'Consumers' in the data centre context include clients of the data centre and cloud services, as well as the users of those clients.[241] The forthcoming Green Claims Directive will complement the Greenwashing Directive by bringing in further regulation obliging companies to verify their voluntary environmental marketing claims.[242]

228 CSDDD art 2(1).
229 CSDDD art 2(2).
230 CSDDD art 24.
231 CSDDD art 27.
232 CSDDD art 37.
233 Regulation 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 (AI Act), OJ 2024 L1689 art 113.
234 AI Act, art 95.
235 Directive 2024/825 of 28 February 2024 of the European Parliament and Council amending Directives 2005/29/EC and 2011/83/EU as regards empowering consumers for the green transition through better protection against unfair practices and through better information (Greenwashing Directive), OJ 2024 L 825.
236 Greenwashing Directive, art 4.
237 Directive 2005/29/EC of the European Parliament and of the Council of 11 May 2005 concerning unfair business-to-consumer commercial practices in the internal market and amending Council Directive 84/450/EEC, Directives 97/7/EC, 98/27/EC and 2002/65/EC of the European Parliament and of the Council and Regulation (EC) No 2006/2004 of the European Parliament and of the Council [2005] OJ l 149 as amended by Regulation 2011/83/EU of the European Parliament and of the Council of on consumer rights, amending Council Directive 93/13/EEC and Directive 1999/44/EC of the European Parliament and of the Council and repealing Council Directive 85/577/EEC and Directive 97/7/EC, OJ 2005 L 304/64.
238 Greenwashing Directive recital 1.
239 Unfair Commercial Practices Directive art 6(2)(d), as amended by Greenwashing Directive, art 1(2)(b).
240 Unfair Commercial Practices Directive art 6(2)(d), as amended by Greenwashing Directive, art 1(2)(b).
241 See Table 1.
242 'Parliament Wants to Improve Consumer Protection against Misleading Claims' (*News European Parliament*, 12 March 2024) https://www.europarl.europa.eu/news/en/press-room/20240308IPR19001/parliament-wants-to-improve-consumer-protection-against-misleading-claims accessed 22 July 2024.

3.3.4 First iteration of the EU legal framework on data centres' sustainability

There has been considerable development of hard and soft law at the EU level, aimed at achieving the EU's overall goal of climate-neutral, highly energy efficient and sustainable data centres by 2030. These legislative efforts have focused on improving the energy efficiency and sustainability of data centre operations and equipment, ensuring recycling and safe disposal of equipment and improving transparency around data centre impacts on sustainability issues through increased reporting obligations to regulators and also the public. The Annex provides an overview of these developments. Taken together these EU instruments form the first iteration of the EU legal framework on data centres' sustainability.

4. Discussion of EU policy discourse

In this section, we will identify the key policy considerations that underpinned the EU law and policy of data centres' sustainability outlined in the previous section and analyse their strengths and weaknesses. As a first step, a policy discourse analysis was carried out on Commission, Parliament, Council and Committee of the Regions official documents that related to data centres in the period 2018-2024. As a second step we added additional research on the key policy issues to identify strengths and weaknesses of the policies adopted.

The EU institutions mostly emphasised unsustainable growth in energy consumption of data centres,[243] with water consumption and electronic waste also being considered, albeit to a lesser extent.[244] Overall, the Commission and Parliament expressly considered data centres most frequently, with the Committee of the Regions also taking up data centres on several occasions, while the Council tended to address digital sustainability more generally.[245] With the upcoming review of the legal framework, the issue of data centre sustainability will become a more salient issue in the EU policy discourse.

4.1 The twin transition

Across the board, EU institutions recognised that digitalisation can bring environmental benefits but also stress the sustainability aspects of digital technologies. This led to the emphasis on a 'twin transition' of digitalisation and sustainability. Locking these two aims together is potentially very powerful; it acknowledges the potential benefits that digitalisation can bring to achieve sustainability, for example better tracking of emissions, while aiming to ensure the impacts on GHG emissions are lessened. The policy measures taken at the EU level focus on encouraging energy efficiency and increasing transparency through reporting.

The Commission's approach rests on the assumption that the tech sector is able to meet its own sustainability ambitions, in short, to decarbonise itself, in tandem with the enormous growth of computing in data centres. For example, in response to a question from an MEP, the Commission noted most ICT companies are already committing to become carbon neutral by 2030.[246] Given the difficulties tech companies have recently admitted in meeting their sustainability pledges, this may no longer be the case, meaning that regulation should enforce meeting decarbonisation goals.

4.2 Energy

This section will discuss the key policy considerations underpinning the EU policy and legislation regarding energy consumption and decarbonisation of data centres.

4.2.1 Electricity consumption forecasts

As noted above, there is considerable uncertainty regarding data centre electricity consumption both globally and in the EU. The Commission has been working with a range of estimates of data centre energy

243 Commission, 'Stepping Up Europe's 2030 Climate Ambition' SWD(2020) 176 final, 34; Commission, 'Path to the Digital Decade' COM (2021) 0247; Committee of the Regions, 'Opinion – Digital Cohesion' (2022) C498/08, [17].

244 Commission, (n 10) 7; Commission 'Report on the State of the Digital Decade 2023' SWD(2023)570, 50; Question for written answer E-001324/20 to the Commission by Manual Bompard GUE/NGL, 4 March 2020.

245 Council, 'Conclusions on Making the Recovery Circular and Green' Document number 13952/20 11 December 2020, [64]-[66].

246 Question for written answer E-001324/20 to the Commission by Manuel Bompard (GUE/NGL) 4 March 2020, Response by Mr Breton on behalf of the Commission 2 June 2020.

consumption, based on a commissioned study published in 2020.[247] In this study, the authors' assumed significant increases both in workloads of data centres and the energy efficiency of servers. However, they also noted it was unlikely increases in efficiency will compensate the growing demand for computing power.[248] The study's forecast outlines a spectrum spanning best and worst case scenarios. In the best case scenario, where the expansion of data centres is slightly lower and the potential for increasing energy efficiency of data centres is exhausted, the study estimated an expected rise of energy consumption to 98.52 TWh in 2030. The worst case scenario assumed an increase of 160 TWh per year in 2030.[249] Something of concern is that, following the IEA's more recent estimates, data centre electricity consumption in the EU in 2022 was at just below 100 TWh and could grow to 150 TWh by 2026.[250] This would mean that the Commission's worst case estimates may already be surpassed, which urgently calls for a new assessment.

4.2.2 Energy efficiency

A key policy consideration for all the institutions, particularly for the Commission, was that improving energy efficiency could help to offset the impact of increased computing in data centres on energy consumption.[251] This was reflected in the development of a set of rules on energy efficiency of servers and data storage products in the Ecodesign Regulation in 2019. Since then the Council has further called for the Commission to establish and adjust existing ecodesign requirements for energy efficient ICT systems.[252]

Regarding the data centre reporting requirement in the EED, the Commission included this in its original proposal, within the broader article on energy managements systems and energy audits. Both the Parliament and Council proposed this be moved to a separate article solely dedicated to data centres. Parliament also went further to include an obligation on Member States to encourage owners and operators of data centres in their territory with an installed power demand of over 1 MW to take into account the European Code of Conduct and CEN/CENELEC/ETSI standards.[253] The Commission appears to have included these standards in the delegated regulations implementing the EU Taxonomy and the CSRD of its own accord, noting that 'a high degree of energy efficiency' as an objective of the Green Deal.[254]

4.2.3 Rebound effect

Something that was given limited, though increasing, attention during the period assessed was the possibility of rebound effects, also known as Jevons' paradox. This is the phenomenon where an increase in energy efficiency of a particular technology leads to an increase in its use, due to a number of factors, for example a decrease in cost, potentially offsetting those gains.[255] Applied to the energy consumption of data centres, this suggests if energy efficiency of data centres is increased, this could in itself increase demand for data centres. Coupled with the push for digitalisation and new technologies, such as cryptocurrency and more recently AI, there is a risk demand will surpass the efficiency gains made. Considering the growth of the data centre sector overall and the fact that renewable energy is still limited, this implies that policy measures geared towards energy efficiency would not suffice to contain the sector's GHG emissions.

The rebound effect did not feature much in the documents in the earlier part of the period assessed. In 2021, the Commission only mentioned it in a footnote to a discussion on the approach taken to estimate

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247 Commission and others 'Energy-efficient cloud computing technologies and policies for an eco-friendly cloud market' (n 28).
248 Commission and others, 'Energy-efficient cloud computing technologies and policies for an eco-friendly cloud market (n 28) 54.
249 Commission and others, Energy-Efficient Cloud Computing Technologies and Policies for an Eco-Friendly Cloud Market (n 28) 62.
250 International Energy Agency (n 67) 32.
251 Commission, 'Mapping of European standardisation organisations activities in support of industrial ecosystems' SWD (2020) 0332, 25; Commission, 'Guidance To Member States Recovery And Resilience Plans' SWD(2021) 0012, 27; Commission, 'Twinning the green and digital transitions in the new geopolitical context' COM (2022)289, 2.
252 Council, 'Digitalisation for the Benefit of the Environment: Council Conclusions' Document number 14169/20, 17 December 2020 [27].
253 Council, 'Proposal for a Directive of the European Parliament and of the Council on energy efficiency (recast) 4 column document' Document number COD 2021/0203 485 – 487.
254 Commission, 'Article 8 of the Taxonomy Regulation' SWD (2021)1 83 final, 2.
255 The exact impacts of the rebound effect are debated, see e.g. Blake Alcott, 'Jevons' Paradox' (2005) 54 Ecological Economics 9; Richard York and Julius Alexander McGee, 'Understanding the Jevons Paradox' (2016) 2 Environmental Sociology 77.

the impact of energy efficiency policies for 2014-2018.[256] More recently, the Commission has taken greater cognisance of the rebound effect, including in its (non-binding) Recommendation on the energy efficiency first principle that an 'overselling' of energy efficiency measures would be counterproductive and should be assessed before implementation.[257] In 2022, the Commission noted that the lack of an agreed framework for measuring the environmental impact of digitalisation, including its possible rebound effects, lead to a marked variation in estimates of global electricity use and of GHG emissions.[258]

Strikingly, in 2023, the Commission stated that the increase in energy and growing reliance on cloud computing to enable technologies such as AI had offset efficiency gains made. [259] It did however qualify that the increase is at a rate that is modest in relation to overall data processing.[260] It noted that in order to keep rebound effects under control, standardised methods to measure positive and negative impacts of digital solutions need to be developed. Therefore, the Commission's knowledge and understanding of the rebound effect developed considerably over the period analysed, though this has not yet featured in an adjustment of the forecasted energy consumption and policy interventions.

Looking to the other EU institutions, there has been some scattered mention of the rebound effect. In the Parliament, during the drafting of a report on AI, a group of MEPs unsuccessfully put forward an amendment highlighting the potential risk of unintended rebound effects.[261] The Council did not address the rebound effect, while the Committee of the Regions in 2022 recommended that digitalisation be accompanied with measures to avoid rebound effects.[262] However, this was not elaborated further or mentioned in later recommendations.

Under the current EU policy approach achieving the 2030 target is only addressed through improving energy efficiency. However these measures do not effectively recognize the sector's growth and corresponding increases in energy consumption and GHG emissions. Therefore, the 2030 target could be missed if the EU policy approach does not account for the growth of the sector and its effect on the overall carbon budget of the EU.

According to Fouquet and Hippe, the rebound effect throws considerable doubt over the Commission's aim to achieve a truly twin transition of digitalisation and decarbonisation. In their research analysing the speed of historical energy and communication technology transitions since 1850, they found evidence to suggest that digitalisation will outpace the transition to renewable energy. Without interventions to accelerate the low carbon transition in tandem with the digital transition, there is a risk of a high carbon (rather than a low carbon) transition of the economy.[263] They suggest that to prevent an imbalanced transformation, policies should promote synergies between the ICT industry (in our case, data centre operators) and low carbon industries, to increase the likelihood of a true twin transition.[264]

It is a welcome development that the Commission's knowledge of potential rebound effects is increasing and the 2030 target should not be relaxed. The Commission should reassess forecast data and based on new data from the reporting requirements, consider if more needs to be done and if the current policies need to be recalibrated.

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256 Commission, 'Evaluation Of Directive 2012/27/EU On Energy Efficiency' SWD(2021)625 final, 28, fn 61.

257 Commission, 'Recommendation 2021/1949 of 28 September 2021 on Energy Efficiency First: from principles to practice – Guidelines and examples from decision-making in the energy sector and beyond', OJ 2021 L 350/9, 29.

258 Commission 'Twinning the green and digital transitions in the new geopolitical context' (n 251) 3.

259 Commission, 'Report on the State of the Digital Decade 2023' (n 244) 50.

260 Commission, 'Report on the State of the Digital Decade 2023' (n 244) 50.

261 Parliament Special Committee on Artificial Intelligence in a Digital Age, 'Amendments 282-555 Draft Report on Artificial Intelligence in a Digital Age' AIDA_AM(2021)703074 Amendment 287.

262 Committee of the Regions (n 243).

263 Fouquet and Hippe (n 5) 13–15.

264 Fouquet and Hippe (n 5) 16. Friere-Gonzalez suggests possible policy avenues, including resource pricing, resources rebound taxation or rebound cap-and trade systems, regulation and changing lifestyles. Jaume Freire-González, 'Governing Jevons' Paradox: Policies and Systemic Alternatives to Avoid the Rebound Effect' (2021) 72 Energy Research & Social Science 101893.

4.2.4 Increasing renewable energy sources

Another key policy aim was to increase the sources of renewable energy available, with the objective of accommodating the increased demand for electricity for computing in data centres.[265] This resulted in the provisions adopted in the RED to speed up the processing for permits for new renewable energy plants. For example, the Commission highlighted that meeting the increased demand through renewable energy sources, such as wind and solar would 'support the greening of data based technologies'.[266] In addition, it highlighted in its guidance to Member States on their post-Covid resilience and recovery plans to direct investment to increase renewable energy for digitalisation.[267] In the Parliament, some MEPs made statements and amendments proposing a requirement for data centres to run on renewable energy, though these were not included in any of the adopted legislation.[268]

A key challenge identified was the limited sources of renewable energy, particularly by the Committee of the Regions, who emphasised currently available renewable energy sources are not capable of absorbing the increasing energy demand of data centres.[269] The Commission included this as a key question in a study initiated in 2023 regarding the integration of data centres and electricity grids. Other aims of this study include understanding drivers and obstacles to data centre energy integration, including rising public opposition to the establishment of new data centres.[270]

While increasing renewable energy sources is an important step, for this to be a sufficient measure, it needs to be shown that renewable energy deployment can grow faster than the energy demand of data centres. In relation to Ireland, Daly demonstrates that data centres have matched the energy growth from wind farms. She notes 'if growing renewables is simply met by growing demand, the fossil fuel use won't fall - it will be like walking up a downwards moving escalator.'[271] The situation in Ireland has clear implications: to avoid similar instances across the EU, it is necessary that the EU recognise the limited renewable energy available for data centres. In addition, the EU needs to better account for the effects of data centre usage of renewable energy on the EU's overall carbon budget, in particular its goal to decarbonise other sectors.

Equally, the current measures do not address the conflict of who gets to use the limited renewable energy and what it is used for. While the major data centre operators such as Amazon, Microsoft and Google advertise their commitment to use of renewable energy, this takes the energy (often purchased under preferential conditions) away from local communities and their needs, such as powering homes and schools. It is hoped that the Commission's 2023 initiated study (discussed above) will yield recommendations for great inclusion of local communities and civil society in deciding what the energy is used for. Another alternative is to

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265 Commission (n 13) 12; Question for written answer E-001883/2020 to the Commission Rule 138 Ciarán Cuffe (Verts/ALE), Answer given by Mr Breton on behalf of the European Commission 26 June 2020; Council, 'Conclusions on Advancing Sustainable Electricity Grid Structure' 30 May 2024 10459/24.

266 Commission 'Twinning the green and digital transitions in the new geopolitical context' (n 251) 3.

267 Commission, 'Guidance to Member States Recovery and Resilience Plans' SWD (2021) 0012 27.

268 Parliament, 'New Circular Economy Action Plan (Debate)' CRE 08/02/2021- 15, statement by Ville Niinistö https://www.europarl.europa.eu/doceo/document/CRE-9-2021-02-08-ITM-015_EN.html accessed 18 July 2024; Parliament, 'Amendments 1-173 Draft Opinion Framework of ethical aspects of artificial intelligence, robotics and related technologies' ENVI_AM(2020)652646, Amendment 88 https://www.europarl.europa.eu/RegData/commissions/envi/projet_avis/2020/652646/amendements/ENVI_AM(2020)652646_EN.pdf accessed 20 July 2024.

269 Committee of the Regions, 'Opinion of the European Committee of the Regions — Amending the Energy Efficiency Directive to meet the new 2030 climate target'' C 301/139 28 April 2022 [20].

270 The specific question asked by the Commission was 'Do data centres consume all available renewable electricity in order to satisfy the additional electricity demand that they generate (to the detriment of the overall footprint of the EU's electricity systems) – or do they have a positive overall 'stirring effect on the development of new renewable projects by creating security of income and reducing risk for project holders (with a beneficial long-term effect)? Commission (n 164) 42.

271 Daly (n 29) 10.

develop requirements for data centres operators to produce their own renewable energy under Art 15 RED as amended,[272] as was argued in Ireland,[273] for example by fitting onside solar panels on data centre structures.

4.3 Overemphasis on waste heat reuse

The potential of data centres as a source of recoverable waste heat played a key role in the EU institutions discussions on a variety of topics relating to the European Green Deal objectives.[274] In particular, the Commission put forward heat reuse as a technical solution for minimising resource usage of data centres housing AI, as well as countering increased energy consumption and emissions of digital solutions more generally.[275] The Committee of the Regions has called for recovery of waste heat to be a preferred activity when available and renewable energy is in limited supply.

Reuse and recovery of waste heat also featured heavily in Parliamentary discourse on the EED and RED.[276] The Parliament and Council's position on what later became Art 26 EED differed on two issues: firstly, the Parliament proposed the threshold be 100kW, while the Council proposed 1MW. In addition, the Parliament proposed that data centres within the threshold be required to utilise waste heat or recovery applications, unless it could show this was not technically or economically feasible. By contrast, the Council favoured merely assessing the costs and benefits of reusing waste heat.[277] The EED as adopted includes the Council's higher threshold, with the Parliament's requirement to utilise recovery technology unless not economically or technically feasible.[278]

Without disputing the potential of reusing waste heat from data centres,[279] a recently published Commission study and funding plans for further research and innovation identify key barriers to waste heat reuse, including low quality of heat produced and difficulties in storage and transportation of heat. [280] Local planning for district heating is also non-existent in almost half of EU Member States, with most States lacking an appropriate legal framework to implement the EED required.[281] Economic barriers include high investment costs for data centre operators and low prices for heat waste, which increases the risk aversion of key actors.[282] A recent example of this was in Amsterdam, where a plan to use a data centre's waste heat to heat 10,000 homes was abandoned, as it was not sufficiently profitable.[283] Therefore it is likely many data centre operators will be able to demonstrate it is not technically or economically feasible to comply with Art 26 EED.

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272 This has also been proposed by the Tony Blair Institute for Climate Change, see Chan and others (n 21). We agree in principle that data centres should produce their own renewable energy but do not endorse the proposal for data centres to have onsite modular nuclear reactors.

273 Pat Leahy, 'Ryan and Coveney in Heated Row over Data Centres' *The Irish Times* (Dublin, 2 March 2024) https://www.irishtimes.com/politics/2024/03/02/angry-row-between-ministers-over-ryan-plan-to-block-heavy-emitting-data-centres/ accessed 4 March 2024.

274 See inter-alia, Commission (n 162) 19, 24-25; Commission, 'Powering a climate-neutral economy: An EU Strategy for Energy System Integration' COM(2020)0299, 6.

275 Commission 'Impact Assessment Accompanying The Proposal For A Regulation Of The European Parliament And Of The Council Laying Down Harmonised Rules On Artificial Intelligence' SWD(2021)0084, 78.

276 Parliament, 'Position of the European Parliament adopted at first reading on 12 September 2023 with a view to the adoption of Directive (EU) 2023/... of the European Parliament and of the Council amending Directive (EU) 2018/2001, Regulation (EU) 2018/1999 and Directive 98/70/EC as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652' EP-PE TC1-COD(2021)0218; Parliament 'Question for written answer E-006526/2020 Answer given by Mr Breton on behalf of the European Commission 9 February 2021'; European Parliament Committee on Industry, Research and Energy, 'Report on a European Strategy for energy system integration (2020/2241)(INI)).

277 Council 'Proposal for a Directive of the European Parliament and of the Council on Energy Efficiency (Recast) - Preparation for the Trilogue' 2021/0203(COD) 384.

278 Council (n 253).

279 See further Koronen, Åhman and Nilsson (n 5).

280 Commission and others, *Study on Promoting Energy System Integration through the Increased Role of Renewable Electricity, Decentralised Assets and Hydrogen – Final Report* (Publications Office of the European Union 2024) 105, 112.

281 Commission and others, (n 280) 127.

282 Commission and others, (n 280) 117–118.

283 Bas Velzel, '"Datawarmte" Voor Gebouwen in Arenapoort Gaat Niet Door: Niet Rendabel Genoeg' *NHnieuws* (28 September 2024) https://www.nhnieuws.nl/nieuws/341104/datawarmte-arenapoort-amsterdam-gaat-niet-door accessed 3 October 2024.

There is a clear potential of utilising waste heat to offset the energy balance of data centres but currently this will often not be a technically or economically feasible solution. Beyond feasibility, the Commission study also highlighted that a focus on heat waste reuse is flawed, in comparison to increasing other sources of renewable energy.[284] In line with the energy efficiency first principle, waste heat should be reduced and, in so far as is possible, eliminated. Therefore the study recommended only unavoidable waste heat be incentivised, while unavoidable heat waste and fossil fuel heat waste should be phased out entirely.[285] This argument was not visible in any of the policy documents analysed.

4.4 Circular data centres

The legislation relating to equipment in data centres requires operators to take steps to properly dispose of its e-waste, to disclose its level of e-waste and through the EU Taxonomy, encourages data centres to facilitate a second hand market for IT equipment. Something not visibly considered is that hardware lifecycles for high performance computing equipment have shortened due to increased emphasis on more energy efficient equipment, suggesting a potential goal conflict between increasing energy efficiency and decreasing e-waste. Equally, the EU has recognised that the industry currently operates in silos that prevent the functioning of such a market, funding a project on Circular Economy for the Data Centre Industry (CEDaCI) which aims to support a systems wide approach to the industry.[286] While progress is being made to connect key actors in order to facilitate a more circular industry, it is not quite clear if there is currently marketplace for second hand equipment. It may be some time yet before such a marketplace is in place, making it a future, rather than present oriented solution.

4.5 The blind spots

EU data centre law and policy focuses on energy efficiency of hardware, with the explosion of AI seeing increased calls from Members of the European Parliament (MEPs) to ambitiously reform the Ecodesign Regulation for servers and data products to counter the corresponding energy consumption.[287] This focus on hardware leaves optimisation of data centre operations through incentivising sustainable software, eradicating dark data and limiting of frivolous uses out of its scope. There was no discussion regarding the type of software run by the equipment or the volume of data being stored. Equally, there is currently no discussion on limiting frivolous uses of digital technologies, for example cryptocurrency mining.[288]

What has come to be known as the 'dark data problem' refers to information assets organisations collect, process or store but fail to use for other purposes.[289] The carbon footprint of storing unnecessary data is of key significance, as 40-90% of the world data is estimated to be 'dark'.[290] As noted by Finck and Mueller, this lack of differentiation between types of data is also a blind spot of EU data sharing regimes, as there are no special provisions facilitating easier access for data used for environmental purposes.[291]

In the context of the Digital Services Act proposal, MEPs were called for 'data sufficiency, aiming at the reduction of data generation, in particular traffic data, including the reduction of associated electricity, water

[284] Commission and others, (n 280) 130–131.

[285] Commission and others, (n 280) 139.

[286] Kristina Kerwin and others, 'Developing a Circular Economy for the Data Centre Industry – How the CEDaCI Project Contributes to Sustainable Decision Making' (2022) 349 E3S Web Conf. https://doi.org/10.1051/e3sconf/202234906007 accessed 16 August 2024.

[287] Parliament, Committee on Industry, External Trade, Research and Energy, 'Amendments 1 - 367 - Draft report A European strategy for data' ITRE_AM(2020)660285, Amendment 314.

[288] Truby (n 27); United Nations University Institute for Water, Environment and Health (UNU INWEH), Sanaz Chamanara and Kaveh Madani, 'The Hidden Environmental Cost of Cryptocurrency: How Bitcoin Mining Impacts Climate, Water and Land' (United Nations University Institute for Water, Environment and Health (UNU INWEH) 2023) https://collections.unu.edu/view/UNU:9528 accessed 22 October 2024.

[289] 'Definition of Dark Data - Gartner Information Technology Glossary' (*Gartner*) https://www.gartner.com/en/information-technology/glossary/dark-data accessed 24 September 2024.

[290] 'How to Use Clean Computing to Combat the Risk of Dark Data' https://www.mesh-ai.com/blog-posts/how-to-use-clean-computing-to-combat-the-risk-of-dark-data accessed 24 September 2024; 'Dark Data: The Elephant in the Data Centre' (*Intelligent CIO Europe*) https://www.intelligentcio.com/eu/2024/01/26/dark-data-the-elephant-in-the-data-centre/ accessed 24 September 2024.

[291] Finck and Mueller (n 24) 116.

and heat consumption and resources from data centres'.[292] However, this was not included in the final Act. The Commission is also supporting research into less data intensive AI models but this solely focuses on AI, rather than data processing and generation in general.[293] There is also an upcoming legislative initiative, the EU Cloud and Development Act, which aims to further enable AI ecosystems in the EU by facilitating training of very large AI models. [294] The proposed Act will also set 'minimum criteria' for cloud services in Europe.[295] While it is not fully clear from the Commission's communication what these minimum criteria will be, there is some suggestion that this will include also minimum energy efficiency criteria.[296]

4.6 Transparency and reporting

This section will discuss the key policy considerations underpinning the newly introduced data centres transparency and reporting requirements at the EU level.

4.6.1 Negotiating transparency

A key emphasis in the measures adopted regarding data centres was to increase transparency on their environmental impact. For example, the Commission has argued that the introduction of the reporting requirements in the EED will 'probably transform the data centre industry, making energy and environmental performance of data centres more visible and make it a key factor in consumer choice and industry planning'.[297] What exactly operators should have to report under the EED was the subject of some debate between the Parliament and Council during the negotiations on the final text of the Directive. The Council's mandate tended to follow the Commission's proposal to the letter, requiring data centres to report some basic information on name and location, floor area, installed power, annual incoming and outgoing traffic and the amount of data stored and processed. Equally the Council followed the Commission's proposal that the data centre report its performance during the full calendar year on KPIs, including energy consumption, power utilisation, temperature set points, waste heat utilisation, water usage and use of renewable energy.[298]

The Parliament built on the Commission's proposal in a number of ways. It successfully suggested the temperature set points be reported with installed power demand and that the annual incoming and outgoing data traffic be reported if available to the operator and taking into account the business model and customer type.[299] Equally it also proposed the amount of data stored and processed in the data centre be reported but only when this affects the energy consumption.[300] Secondly, the Parliament's amendments sought to link the reporting obligations more closely to the relevant technical standards.[301] The final agreement on the EED did reference the KPIs in the CEN/CENELEC standards in an Annex[302] and the Commission's Delegated Regulation accordingly links reporting obligations to these KPIs.[303]

Equally, the scope of data centres that would come under this requirement was debated between the Parliament and Council. The first obligation is the reporting obligation contained in Art 12(1). The Parliament sought to lower the threshold of this requirement to data centres with energy inputs exceeding 100 KW.[304] By contrast, the Council in their initial proposal did not quantify the power input, instead following the

292 Parliament Committee on the Internal Market and Consumer Protection 'Amendments 1592 - 1872 Draft report Single Market For Digital Services (Digital Services Act) and amending Directive 2000/31/EC' IMCO_AM(2021)695161, Amendment 1834.

293 Parliament, 'Answer given by Mr Breton on behalf of the European Commission to Parliamentary Question E0001344/2022 ASW' 1 July 2022.

294 Commission, 'A Competitiveness Compass for the EU' (Communication) COM(2025) 30, 5.

295 Commission (n 294) 5.

296 Luca Bertuzzi and Oscar Pandiello, 'AI Cloud Services Face Minimum Energy-Efficiency Criteria in the EU; (MLex) https://www.mlex.com/mlex/articles/2288451/ai-cloud-services-face-minimum-energy-efficiency-criteria-in-the-eu accessed 8 February 2025.

297 Commission, (n 164) 51.

298 Council, (n 253), 537-538.

299 EED Annex VII (b) and (c).

300 Council, (n 253) 537.

301 Council (n 253) 538-540.

302 Parliament, 'Provisional Agreement Resulting From Interinstitutional Negotiations' 29 March 2023 ITRE_AG(2023)746697, 185.

303 I.e. Power Usage Effectiveness (PuE), Renewable Energy Factor (REF), Energy Reuse Factor (ERF), Carbon Usage Effectiveness (CUE) and Water Usage Effectiveness (WUE), see Common European Rating System for Data Centres Regulation Annex II and III.

304 Council (n 253) 297.

Commission's proposal of 'significant'. Eventually, the compromise threshold agreed was 500 kW.[305] This still covers the category of 'small data centres' but will not include as many data centres that are smaller and/or older. The Commission Study on Greening Cloud Computing has noted that the remaining energy saving potentials in data centres bigger than 1 MW are rather low, meaning the focus should be on smaller and older data centres.[306] Setting the lower limit at 500 kW excludes smaller, on premises data centres, which tend to be the least efficient.

4.6.2 Reporting of water consumption

An interesting aspect of the EED and Commission Delegated Regulation on the first phase of the establishment of a common Union rating scheme for data centres is that data centre operators will have to report information regarding water consumption, including total water input, total potable water input and water-usage effectiveness (WUE).[307] The Commission will for the first time have granular data on about data centre's impact on water resources.[308] However, the only publicly available information will be the total water consumption of all reporting data centres and average WUE for data centres at the member state and EU level.[309] Therefore, future publicly available information should include the granular data, made available to the Commission, not just aggregated data. Future reporting requirements should also further address water stewardship programmes and include reporting on replenishment in the areas where the data centre is located.

4.6.3 Transparency for whom?

A key argument made particularly by the Parliament is that increasing reporting will allow for greater public participation and action regarding data centres.[310] A number of benefits of this approach were noted in the documents, including raising awareness and knowledge of data centre operators and clients.[311] Something to consider is that, regarding the data that will be published in conformity with the EED reporting requirements, the Commission will only make aggregated and calculated metrics available. The data will be aggregated at a Member State or regional level. As pointed out by the Sustainable Digital Infrastructure Alliance, this will not allow for comprehensive analysis and comparison across the different regions.[312] What is more, without greater public transparency, it will be very difficult for local communities and civil society to gain insights into the energy consumption and sustainability impact of data centres at the local level where the impacts are felt.

The transparency mandated by the EU Taxonomy and CSRD, by contrast, is very detailed, which will provide a wealth of information for users of sustainability statements. Something to bear in mind is potential issues in comparability of disclosures for customers across different companies. These newly introduced reporting requirements, in addition to those introduced in the AI Act and Greenwashing Directive mean that companies have to disclose a variety of information in different reports and to different actors. Equally, the complexity of the key performance indicators disclosure templates for the EU taxonomy can be difficult to interpret without guidance. Some companies may present the same information differently, due to some uncertainties regarding interpretation of the EU Taxonomy and CSRD requirements.[313] The Commission has taken steps to provide guidance on presentation of information under the EU taxonomy and CSRD, including an EU Taxonomy navigator tool, which includes a frequently asked questions repository and a

305 Council (n 253) 297.
306 Commission and others (n 42) 90.
307 Common European Rating System for Data Centres Regulation, Annex II (h) and (i).
308 Mytton (n 8).
309 Common European Rating System for Data Centres Regulation, Annex IV.
310 Parliament 'Resolution of 3 May 2022 on artificial intelligence in a digital age' P9_TA(2022)0140 [185].
311 Commission (n 164) 51.
312 Sustainable Digital Infrastructure Alliance, 'SDIA Comments on Delegated Act' (2023) 11 https://sdiav2.cdn.prismic.io/sdiav2/65bcf2b8615e73009ec43c66_ResponseSDIAEED.pdf accessed 27 September 2024.
313 Jan Niewold, 'How to Navigate EU' Taxonomy's Complex Rules' (EY) https://www.ey.com/en_gl/insights/assurance/eu-taxonomy-report accessed 1 October 2024; KPMG, 'Setting the Baseline towards Transparency' (2023) 5 https://assets.kpmg.com/content/dam/kpmg/pl/pdf/2023/11/pl-setting-the-baseline-towards-transparency-EU-taxonomy-report.pdf accessed 1 October 2024.

guidance document for non-experts called the EU Taxonomy User Guide.[314] Finally, it will be several years before all the reporting requirements come into effect for all data centre operators, meaning it will be some time before the full picture is available to both the EU legislator and other stakeholders.

In addition to increasing public access to information on data centres, another function of increasing transparency, particularly in the EU Taxonomy, was to steer more investment to greener data centres and proven digital solutions as a sustainable activity.[315] This assumes that increasing transparency on its own is sufficient to shift investment towards more sustainable practices. To ensure this hoped-for shift in investment materialises, the transparency measures should be strengthened by economic incentives, particularly to support a second hand market for second-hand data centre equipment.

4.6.4 Reporting of location-based emissions

A different issue that arises in connection with reporting data centres' energy and carbon footprints involves the attribution of Renewable Energy Certificates (RECs).[316] In practice operators oftentimes evade reporting location-based scope 2 and 3 emission even though this represent the emissions that occur at the site of the data centre. Discussion of RECs and location based reporting of renewable energy usage did not feature in the discourse of the EU institutions, likely as the drafting of the standards was the responsibility of the European Financial Reporting Advisory Group (EFRAG). Under the EED data centre operators can report RECs with a guarantee of origin which they have sourced anywhere in Europe, mostly in Northern Europe, and attribute them to any European data centre location in Europe.

The use of market-based reporting is allowed under the Delegated Regulation establishing a common data centre rating system[317] and can lead to operators reporting 100 % renewable energy consumption in their EED reports; although they would not be allowed to claim zero emissions. In a similar fashion, the EU Taxonomy allows this in Activity 8.1, as it incorporates the European Code of Conduct and the CEN-CENELEC standards definition of the KPI on Renewable Energy Factor (REF) including all renewable energy purchased from the utility (with a guarantee of origin) and produced on site.[318]

Reporting under the CSRD also allows data centre operators to count RECs with a guarantee of origin towards the KPI on REF.[319] However, data centre operators will also be required to differentiate between location-based emissions and market-based emissions in its disclosures.[320] This is important, as it will give a clearer picture of where emissions are being released. In its forthcoming assessment of data centre sustainability, the Commission should assess the difference between location-based and market-based emissions and be vigilant to assess and address the inclusion of RECs in data centre's renewable energy mix.

4.7 Public value dimension of EU sustainability policy for data centres

Aside from twinning sustainability and digitalisation, data centres and their material impact on the environment merit serious public value consideration. In the following we consider three dimensions; the common good, the local and the global interests.

4.7.1 Common good oriented computing

In the parliamentary debates and amendments, some MEPs argued that natural resources and renewable energy should not be consumed by data centres at the expense of citizens.[321] Incorporating a public value

314 'EU Taxonomy for Sustainable Activities - European Commission' (*European Commission*) https://finance.ec.europa.eu/sustainable-finance/tools-and-standards/eu-taxonomy-sustainable-activities_en accessed 16 October 2024.

315 Commission (n 244) 32.

316 O'Brien (n 75).

317 Common Union Rating Scheme for Data Centres Regulation, Annex II, 1(p)-(q).

318 Commission and others, '2024 Best Practice Guidelines for the EU Code of Conduct on Data Centre Energy Efficiency' (n 163) 13., which cites CEN/CENELEC/ETSI EN 50600-4-3 3 Data centre facilities and infrastructures Part 4-3: Renewable Energy Factor.

319 CSRD article 29(b)(5).

320 ESRS E1, [49], [52], AR [24], AR [47] AR 47,48 and 54.

321 Parliament, 'Preparation of the European Council meeting of 21-22 October 2021 (debate)' P9_CRE-REV(2021)10-20(4), statement by Chris McManus; Parliament, 'One-minute speeches on matters of political importance (debate)' P9_CRE-REV(2021)11-22(23), statement by Clare Daly.

oriented approach is advocated by Lucivero et al, who highlight that despite the involvement of big tech and corporations, data-driven innovation is presented as a 'tool for delivering the common good'.[322] However, not each and every use of computing contributes to the common good, as the example of proof-of-work crypto mining illustrates.[323] As noted by Lucivero et al, to leave these decisions to the commercial sector risks 'the common good and justice' of the many being neglected in favour of the profits of the tech sector.[324]

One promising suggestion proposed by researchers and environmental organisations are environmental impact assessments.[325]In the context of AI applications, van Wynsberghe suggests introducing proportionality frameworks to assess whether training or tuning of an AI model for a particular task is proportional to the carbon footprint.[326] She argues that 'sustainable AI must also embody the tension between innovation in AI for sustainable development goals, as well as explicitly targeting the sustainability of AI training and usage.'[327] Outside of putting AI to work for sustainability, the use of an AI model can only be considered sustainable where the sustainability impacts of the development and use of the AI itself are outweighed by the purpose and impact of its existence.[328] These considerations could arguably be extended beyond AI model training to the most resource intensive types of computing applications.

4.7.2 Local and global attribution of computing

A public value oriented approach to data centres and cloud computing also requires identifying affected stakeholders and their rights, interests and vulnerabilities. The European Declaration on Digital Rights and Principles for the Digital Decade enumerates these key rights, including that people should be at the centre of the digital transformation and that digitalisation should avoid significant harm to the environment.[329] Something to consider is that the growth of (hyperscale) data centres collectivises the environmental costs of computing, burdening some communities more than others, while the benefits or profits of the development remain privatised. Therefore greater community involvement and cognisance of local interests in the decision making processes around hyperscale data centre development is essential.[330] The collectivised impact of one or a cluster of data centres justify a greater level of community participation than currently foreseen in the EDD. To better share the burden, policy at the EU level should enable smaller managed and federated data centres to also be a part of the future of data centres in Europe.

Next to local interests, the global effects of distributed computing must be accounted for. As computing can take place remotely EU policy ought to be broadly aware about the computing workloads EU customers consume in third countries and vice versa. Attributing the Scope 3 emissions from computing workloads in third countries is already required under the CSRD corporate sustainability reporting standards.[331] In the event that a significant imbalance of computing workloads builds up this could imply a circumvention of EU sustainability standards for data centres. Third countries where regulation of data centres' sustainability are significantly lower than in the EU could otherwise bear the brunt of EU's outsourcing of computing needs. Such would contradict the spirit of sustainability efforts in the EU and run afoul of the UN Sustainable Development Goals. Therefore, discussion of data centre sustainability should integrate concerns at the local and national level into EU level policy.

322 Lucivero (n 3) 1024.
323 Isabella Gschossmann et al, 'Mining the environment – is climate risk priced into crypto-assets', Macroprudential Bulletin, 11 July 2022, https://www.ecb.europa.eu/press/financial-stability-publications/macroprudential-bulletin/html/ecb.mpbu202207_3~d9614ea8e6.en.html accessed 1 October 2024.
324 Lucivero (n 3) 1023.
325 Peter Gailhofer, 'The European Parliament's Amendments to the AI Act' https://www.oeko.de/fileadmin/oekodoc/Policy_Paper_The-European-Parliaments-amendments-to-the-AI-Act.pdf. accessed 28 February 2025.
326 van Wynsberghe (n 19).
327 van Wynsberghe (n 19) 215.
328 Falk and van Wynsberghe (n 19).
329 European Declaration on Digital Rights and Principles for the Digital Decade (n 131).
330 See e.g. Parliament, 'Energy Efficiency Recast Debate' P9_CRE-REV(2022)09-12(17), statement by Mick Wallace.
331 ESRS E1 Annex A, AR 48 and AR 51.

5. Conclusion: towards planet-proof computing by 2030

To borrow Ensminger's analogy of the cloud as a factory,[332] it is clear that despite its seemingly incorporeal and innocuous presence in our lives, the infrastructure needed to facilitate digitalisation and operate digital technology has a very real impact on our planet. Just like any other manufacturing or heavy industry, the rapid growth of computing and data storage in data centres merits further consideration from a sustainability standpoint, given its impact on energy consumption and resulting GHG emissions, water consumption and e-waste. Despite voluntary commitments by major data centre operators to reduce their environmental impact, achievement of these commitments is becoming increasingly endangered by heavy investment in data centres for the development of new digital technologies such as AI. Media reporting on the sustainability of data centres has ensured the issue has become higher on the agenda of the EU and its Member States, some of whom have taken steps to regulate and even place a moratorium on new data centre developments.

The EU's emphasis on the twin transition serves to connect sustainability and digitalisation policies both ways. On the one hand, there has been considerable recognition at the EU level of the potential for digitalisation to be a key critical enabler in achieving the goals of the EU Green Deal. On the other hand, the resulting increased need for digital infrastructure and its negative sustainability impacts have been acknowledged and need to be mitigated. In response an increasingly elaborate framework on data centre sustainability has been developed, with the aim of achieving 'climate neutral, highly energy efficient and sustainable data centres by no later than 2030'. There have been significant steps towards improving knowledge and transparency regarding data centre environmental impact through reporting requirements under the EED. The detailed data that will be reported per Art 12(1) EED will be the basis of a forthcoming Commission report. Equally the proposal for a Cloud and AI Development Act proposes setting minimum criteria for cloud services providers.

The Commission's review and the proposal for a Cloud and AI Development Act will be key to shaping the future of the data centre sector in line with societal needs and planetary boundaries. Necessarily, the Commission is required to update its data centre electricity consumption forecasts, as its current worst case estimates for the data centre sector's energy consumption in 2030 are likely to be outpaced. The review will be an important moment and an opportunity for the EU legislator to adapt and strengthen its regulatory approach to data centre sustainability. The key issue will be how the EU will respond to the growth of the data centre sector, in order to keep with the 2030 sustainability target. One option to contain the rebound effect would be to adapt and strengthen its regulatory approach to data centres beyond energy efficiency and manage this sector's growth in step with the availability of renewable energy. Moreover, the EU and its Member States will have to join-up their policy efforts and coordinate EU sustainability policy with new data centre developments in the Member States. Finally, there are still key developments to be made before it will be a technically or economically feasible option for most data centres to be a source of waste heat. The worst possible outcome would be that the EU legislator would not enforce the 2030 sustainability targets but simply correct its electricity consumption forecast upwards.

Something to be further considered is how to ensure reporting on data centre sustainability translates into public transparency and tangible steps to improving on environmental impact. The Commission should assess the reported information regarding location-based and market-based emissions to increase transparency regarding RECs, promoting the use of local renewable energy for data centres. Finally, while there is considerable legislation regulating data centre equipment, the focus remains solely on hardware. Introducing policy measures incentivising of energy efficient software, tackling the dark data problem and regulating frivolous uses of data centre computing capacity will be necessary.

It is important that the data reported and collected by the EU is accessible and understandable by the public, not just the Commission and Member States' competent authorities. The EU will release some data reported pursuant to the EED in a publicly accessible database. However, as this data will be aggregated at

332 Ensmenger (n 2) 34.

the Member States' and EU levels this will not make data centre sustainability impacts more transparent. The new database will not overcome the difficulties for local actors such as civil society and local communities to identify the impact of specific data centres at the local level. More efforts are needed to ensure meaningful public transparency regarding the data centre sector at local, national and EU levels.

Other transparency measures including the CSRD, CSDD, EU Taxonomy and AI Act, address specific large organisations engaging in multiple activities, not only their data centre activities. While these disclosures do provide more granular data, complexities with sheer volume, as well as presentation of the material means transparency for the general public may be hindered. The transparency measures also aim to increase investment towards more sustainable data centre practices. However, if not also supported by economic incentives, this may not materialise. Therefore it is not certain that these disclosures will have the tangible impact on investment decisions that are anticipated, particularly given many of the disclosure requirements will only enter into force incrementally over the next few years.

In addition to adapting the current framework for data centres, a promising avenue for future policy could be to integrate public value oriented requirements in relation to significant computing workloads. In order to keep with the 2030 sustainability target it may necessary to leverage proportionality frameworks to assess the purported good of particular digital technologies or services in relation to their environmental costs. EU industrial policy should prioritise locally managed and sustainable computing infrastructures, which would moreover strengthen EU strategic autonomy. Finally, we highlight that the global effects of distributed computing should be accounted for so that increased data centre regulation does not lead to an 'outsourcing' of EU computing needs to third countries where regulation of data centre sustainability is significantly lower. It is essential that future policy not only address technical considerations but also consider the effects of increasing digitalisation on a global, not merely European scale.

This article aims to make the complex EU regulatory framework that governs data centres' sustainability more accessible. Having reviewed a considerably large body of EU legislation and policy we cannot avert the impression that the current policy approach would not achieve to contain an increase of the ecological footprint from the growth of the data centre sector in the EU. It is important to broaden the EU level discourse from the currently highly technical fora towards a broader societal discussion about the sustainability impacts of digitalisation and AI. Importantly, this is an area in need of multidisciplinary research where researchers from engineering, data and computer science collaborate with the social sciences, including legal studies, and humanities to further the integration of sustainability and digitalisation.

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Annex. EU legal framework on data centre sustainability.

Name	Relevant Articles/ Annexes	Aim	Important thresholds	Entered into force for Member States
Energy Efficiency Directive	Art 11	Energy efficiency first principle assessment, Energy management scheme Energy audit	<€100 million <85TJ over 3 years 10TJ< x > 85 TJ	11 October 2025
	Art 12	Reporting obligations	<500kW	15 May 2024
	Art 12(4)	Encourage use of best practices	<1 MW	11 October 2025
	Art 26	Waste heat utilisation and recovery	<1 MW	11 October 2025
Delegated Regulation on a Common Union Rating System for Data Centres	Annex I-IV	Key Performance Indicators	<500kW	15 September 2024, then 15 May 2025, then annually.
Renewable Energy Directive (As amended)	Art 16a-e	Streamline permit process		1 July 2024
	Art 15(a)(3)	Onsite generation of renewable energy	To be determined by Member States	21 May 2025
	Art 24(6)(b)	Coordination between data centres and district heating and cooling		21 May 2025
EU Taxonomy Regulation	Art 8	Reporting requirements		Varies depending on size of company
EU Taxonomy Climate Delegated Act	Activity 8.1 Climate Delegated Act	Reporting requirements for activity on data processing hosting and related activities.		From 1 January 2022, varies depending on size of company
EU Taxonomy Environmental Delegated Act	Activity 5.6 Environmental Disclosures Act	Reporting requirements for activity contributing to circular economy		From 1 January 2024, Varies depending on size of company
Corporate Sustainable Reporting Directive	Art 1(3) and 1(4)	Scope of companies required to report		Varies depending on size of company
	Art 1(4)	Carry out impact and financial materiality assessment.		Varies depending on size of company
	Art 4	Disclosure of sustainability statement		Varies depending on size of company
	ESRS E1, Disclosure E1-6, Annex AR 48,51	Disclosure of GHG emissions from purchased cloud services in Scope 3.		Varies depending on size of company
Corporate Sustainability Due Diligence Directive	Arts 7-16	Liability for violations of obligations to reduce and mitigate environmental impacts	Companies over 1000 employees and net turnover worldwide of €450 million.	Varies depending on size of company, between 2027-2029.
EU Green Public Procurement Criteria	Non-binding	Provides guidance on purchasing products and services with reduce impact.	Refers to best practices standards	
Ecodesign Regulation on servers and data storage products	Annex II	Sets down specific requirements for servers.		April 2019

Annex. Continued

Name	Relevant Articles/ Annexes	Aim	Important thresholds	Entered into force for Member States
WEEE Directive	Art 5(5) Art 14(5)	Provision of collection of equipment Provide necessary information for separate collection.		13 August 2012
Medium Combustion Plants Directive	Art 11(2) Art 5	Requirement of MS to collect information and transmit to Commission Permits system	1-50MW	19 December 2017
Industrial Emissions Directive	Art 4	Permits system	Over 50MW	26 January 2011
Industrial Emissions Portal Regulation	Art 5	Reporting and information for permits	Over 50 MW	1 January 2028
AI Act	Art 51 and Annex XIII	Conditions for classification of systemic risk, including energy consumption.		2 August 2026
Greenwashing Directive	Art 4	Requirements for making environmental claims		27 September 2026
Green Claims Directive	To be confirmed.	Liability for misleading environmental claims.		Undergoing legislative process.