The Paris Journal on AI & Digital Ethics, N.2, September 2026.

Environmental Impacts of Data Centers and Criminal Law Responses: A Comparative Perspective

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Abstract

The rapid development of Artificial Intelligence (AI) in recent years has undeniably generated significant benefits for society across a wide range of fields. At the same time, however, it has raised concerns regarding the environmental impact associated with data centers, particularly in relation to mineral extraction, the construction and maintenance of data center facilities, the extensive use of water for cooling purposes, and the consumption of energy derived from non-renewable sources, which may contribute to air pollution and greenhouse gas emissions. Several States are planning the construction of a substantial number of new data centers in the coming years. However, this development entails significant risks to the environment, as well as to human health and safety. This paper aims to analyze the current state of the art regarding the construction and operation of data centers, with particular attention to the risks they pose to workers' health and safety, including the development of occupational diseases and, in extreme cases, fatal accidents. Furthermore, it explores potential issues of criminal liability for companies and managers arising from environmental harm, including water contamination, violations of regulations governing waste management and wastewater disposal, and offences related to environmental pollution. These risks must be carefully considered by managers and companies operating data centers in order to ensure the protection of fundamental legal interests such as the environment, human life, and health, while at the same time promoting sustainable economic development and technological innovation.

Keywords

Data Centers, Criminal Law, AI Sustainability, Environmental Impacts of AI, Crime Prevention.

1 Introduction

The increasingly widespread use of artificial intelligence (AI) systems in contemporary society, while offering undeniable benefits in various fields, also entails certain risks. Among these is the potential impact that such technologies may have on the environment and on public health (Cork and Dominici, 2026; United Nations Environment Assembly, 2025; Di Donato, 2025, b; Jian, Xian, and Chen, 2025).

From the standpoint of environmental criminal law, the current landscape reveals a tension between competing economic and technological interests and the protection of fundamental legal interests, such as life, health, and the environment.

In order to be averted, such risks require what may be described as "risk management", bearing in mind that achieving a zero-risk society is exceedingly difficult in the contemporary world. Indeed, the complete elimination of risk would ultimately entail living without AI altogether, which, at the present stage of technological development, appears unrealistic and impractical (Jacobs, 2025).

In the field of environmental criminal law, particularly within the legal systems of the Member States of the European Union, risk management can (and should) be pursued not only through compliance with sector-specific regulations, but also through adherence to a number of fundamental legal principles.

Among these are (or, where they are not yet recognized, ought to be recognized) the precautionary principle, the principle that preventive action should be taken, the principle that environmental damage should, as a priority, be rectified at source, and the polluter-pays principle. In the European Union, these principles are enshrined in Article 194(2) of the Treaty on the Functioning of the European Union. Similar principles, or at least some of them, are also recognized by other States and international organizations.

The content of these principles, although largely apparent from their formulation, nonetheless merits brief clarification in the context of AI and environmental protection, insofar as they should serve as guiding principles for those involved in the development and operation of data centers.

On the one hand, the precautionary principle provides that where a given policy or course of action may entail a risk of specific and identifiable harm to individuals or the environment, the absence of full scientific certainty cannot justify a failure to adopt precautionary measures, subject to subsequent review in light of further scientific evidence (Reins and Ala-Lahti, 2026, pp. 6-8; Ruga Riva, 2025, pp. 41-44; CJEU, 2024, para. 40; Commission of the European Communities, 2000).

On the other hand, the principle of prevention is aimed at averting environmental damage, for example to protected species or natural habitats, as well as to water and soil. This principle entails the adoption of preventive measures designed to anticipate and avoid environmental harm before it occurs (Maletto, 2024).

Although these two principles apply in different contexts (the former operating in situations of scientific uncertainty and the latter in cases where risks are more clearly established) they are nonetheless closely interconnected. Given their interconnection, in the context of data centers, and notwithstanding authoritative technical studies highlighting the pollution generated by such facilities, it is submitted herein that, alongside the principle of prevention, the precautionary principle should also be taken into account with respect to any potentially unknown risks that have not yet emerged.

The polluter-pays principle is readily understood as imposing on polluters the obligation to bear the environmental and social costs of their activities. For instance, the Court of Justice of the European Union affirmed that EU Directive 2004/35, in line with the polluter-pays principle, «*seeks to hold operators financially liable where, on account of occupational activities posing a potential or actual risk for human health or the environment, they have caused environmental damage, so as to induce them to adopt measures and develop practices to minimise the risks of such damage*» (CJEU, 2020, para. 74). Similarly, the principle that environmental damage should, as a priority, be rectified at source ensures that harm or pollution is addressed at its place of origin (CJEU, 1992).

In essence, industrial and technological development may (and, in some cases, ought to) continue; however, it cannot proceed without appropriate safeguards and legal mechanisms designed to ensure an appropriate balance between the rights and interests at stake.

Such an undertaking is not without difficulty; yet it is necessary, especially considering that, in several jurisdictions, like Italy, Spain, Germany, and France, the environment is recognized as a constitutionally protected legal interest, and thus assumes particular importance for the legislature. Even in legal systems where no explicit constitutional provision exists, environmental protection is ensured, for instance, through States' participation in international organizations that, through a range of instruments, pursue environmental objectives.

The emerging issue of AI data centers can be understood within the broader framework of risk management, a concept well known to criminal law scholarship. Although data centers are a relatively recent phenomenon, it is nonetheless possible, from the perspective of environmental criminal law, to draw on comparative experiences and cases that have emerged in different parts of the world that lead to pollution and health issues (Di Donato and Giovinazzo, 2025). These experiences may help to clarify the nature of the criminal law responses adopted by legal systems once recourse to criminal law became necessary and whether the responses developed in the past remain adequate in addressing the prospective risks associated with AI data centers.

This line of reasoning, however, must be grounded in a preliminary assumption: criminal law is neither the primary nor the principal instrument for balancing the competing rights at stake in this field. This follows for a straightforward reason. Criminal law should operate as an *ultima ratio*, that is, as a mechanism of last resort, intervening only where other remedies have proved ineffective (Melander, 2013, p. 45 *et seq.*; Kaufmann, 1974, p. 89 *et seq.*). For this reason, other branches of law, beginning with civil and administrative law, should take precedence. It is no coincidence that the European Union is actively engaging in this area through research initiatives, regulation, and directives aimed at establishing a civil regulatory framework (EU/2023/1791 Directive (Energy Efficiency Directive); Delegated Regulation (EU) 2024/1364; EU Data Centre Energy Efficiency Package). The EU/2023/1791 Directive (Energy Efficiency Directive) introduced mandatory public reporting requirements for data centers with a power demand above 500 kW. The Delegated Regulation (EU) 2024/1364 established harmonized reporting elements and the first phase of a Union rating scheme. The European Commission recently announced follow-up work through the Data Centre Energy Efficiency Package, including assessment of reported data, a rating scheme and work towards minimum performance standards.

What, however, might occur if recourse to criminal law were to become necessary in relation to AI data centers? In order to address this question, it is essential to examine: (a) the environmental impacts that AI data centers may generate; and (b) the criminal law responses adopted or that can be adopted based on past similar cases within the relevant legal systems to counter such adverse effects.

2 Environmental Impacts of Data Centers: A Brief Analysis

In order to properly assess the actual impact of AI data centers, reference must be made to the most recent technical and scientific literature on the subject, as each stage of the AI lifecycle may entail negative environmental effects (Varoquaux, Luccioni, and Whittaker, 2025, p. 65 *et seq.*; Lenoir and Parker, 2025, p. 47; Falk, Kluge Corrêa, Luccioni, Biber-Freudenberger, and van Wynsberghe, 2025). The wide range of both direct and indirect impacts arising across the entire AI "supply chain" and its infrastructure renders such impacts inherently complex and uncertain to evaluate and quantify (International Energy Agency, 2025, p. 100; Luccioni, Jernite, and Strubell, 2024, p. 94; Pasek, Vaughan, and Starosielski, 2023; Kaack, Donti, Strubell, Kamiya, Creutzig, and Rolnick, 2022).

The literature generally categorizes the environmental impacts of data centers into several principal areas: (a) mineral extraction for the construction of data center infrastructure and equipment; (b) water usage, particularly for cooling; and (c) energy consumption associated with their operation and the resulting environmental emissions.

2.1 Mineral Extraction for the Construction of Data Center Infrastructure and Equipment

The first critical stage concerns the extraction of the minerals required for the construction of data centers and their related infrastructure (Allgood and Hulak, 2025). The literature highlights that, contrary to the initial perception of AI as operating in an immaterial dimension, its functioning in fact requires «*thousands of servers organized in racks, accompanied by storage systems, network devices, processing units, power supplies, backup power systems, cooling systems, sensors for environmental monitoring, connection cables, and various other essential devices*»(Stacciarini and Gonçalves, 2025, p. 3). All of these infrastructures, however, depend upon scarce and valuable materials, including, as scholars have observed, rare earth elements, tantalum, and cobalt (Falk, Kluge Corrêa, Luccioni, Biber-Freudenberger, and van Wynsberghe, 2026, p. 1).

In this context, the environmental impact is felt, primarily, in the regions where the raw materials necessary for its construction are extracted. For a long time, the environmental impact of extraction received limited attention, largely because it occurred in the Global South or in geographically remote countries and primarily concerned fuel extraction activities taking place far from the jurisdictions in which the extracted resources were ultimately used (Agusdinata, Eakin, and Liu, 2022). The social and environmental risks associated with mineral extraction, however, are now regarded as broadly comparable to those traditionally linked to fuel extraction (Agusdinata, Marin, Iloeje, Matsubae, Kaunda, Sharma, and Coates, 2026). Beyond the harms arising from exposure to toxic substances during extraction activities, further concerns relate to labor exploitation and the appropriation of resources within what has been described as the "AI race", pursued for both civilian and military purposes (Okeowo, 2025; Di Donato, 2025).

Secondly, the negative impacts of extraction may now also indirectly affect the areas in which data centers are constructed, as well as local communities and, above all, workers who come into contact with construction materials. Recent studies show, for instance, that graphics processing units (GPUs), widely used in many data centers (Leswing, 2023), consist to a significant extent of elements classified as hazardous due to their toxic properties under relevant exposure conditions (Falk et al., 2026, p. 4). Exposure to such elements may result in «*lung cancer, neurological impairment, gastrointestinal disorders, and other longterm health impacts*» (Falk et al., 2026, p. 4).

As will be seen shortly, this may also give rise to criminal liability on the part of both the company and the individuals responsible for overseeing workers' health and safety, where a causal link between the onset of the disease and the relevant work activity is established.

2.2 Water Usage

According to recent research, data centers require large quantities of water (De Vries-Gao, 2026; Yañez-Barnuevo, 2025; Commins and Irion, 2025, p. 2). Indeed, a recent United Nations report highlighted the magnitude of the water footprint associated with digital infrastructure. For example, the report estimated that the electricity consumption of data centers in 2025 was associated with a water footprint of approximately 4.5 trillion liters, equivalent to the volume required to fill around 1.8 million Olympic-sized swimming pools or to meet the annual basic domestic water needs of more than 600 million people in Sub-Saharan Africa (Aczel, Chamanara, Matin, Farsi, Marwala, and Madani, 2026, p. 10). Similarly, the water footprint associated with GPT-5 training has been estimated at approximately 1 billion liters, corresponding to the annual domestic water needs of more than 135,000 people in Sub-Saharan Africa (Aczel et al., 2026, p. 9).

One of the primary uses of such water is on-site cooling; however, according to some studies, indirect water consumption is also associated with semiconductor manufacturing and energy supply (Barnett-Itzhaki, 2026, p. 2; Gamazaychikov and Luccioni, 2025; International Energy Agency, 2025, p. 242). The amount of water consumed by a data center varies considerably depending on factors such as cooling technology, local climate conditions, and the source of electricity supply (Yañez-Barnuevo, 2025; International Energy Agency, 2025, p. 242).

Although transparency regarding water consumption across the different stages of data center operation remains limited, the literature has highlighted the need for greater transparency while recent studies have provided indicative estimates of both direct and indirect water use (Privette, Barros, and Cai, 2026).

Direct operational water consumption (associated with cooling systems) has been estimated at approximately 1-9 liters of evaporated water per kWh of server electricity consumption, depending on cooling technology and climatic conditions (Li, Yang, Islam, and Ren, 2025, p. 57).

Indirect water consumption is also substantial. Electricity generation alone may require up to 7.6 liters of evaporated water per kWh in the United States, although this value varies considerably depending on the regional electricity mix. In addition, semiconductor manufacturing is highly water-intensive, with a typical chip fabrication facility consuming approximately 38 million liters of ultrapure water per day, primarily for equipment cooling, wafer cleaning, and semiconductor processing (Privette et al., 2026; Irwin-Hunt, 2023).

Data centers may rely on both potable and non-potable water sources. While a growing number of companies have recently shifted towards the use of non-potable water, potable water continues to be used by several operators (Mytton, 2021, p. 1).

One positive aspect is that several major companies that are building data centers have declared their intention to become "water positive" by 2030 (International Energy Agency, 2025, p. 244; Commins and Irion, 2025, p. 11). If such commitments were effectively implemented across the industry, the risks associated with water consumption could be substantially reduced, but not eliminated especially from the criminal law perspective where the water should be purified.

From this point of view, however, only limited scenarios are relevant. By way of preliminary reference to what will be discussed later, one such scenario concerns the failure to comply with the procedures laid down by the State in which the data center is located for the proper disposal of used water, which in certain jurisdictions may be classified as wastewater. Where this is not the case, attention must nonetheless be paid to the temperature of the water upon its discharge into natural water bodies after use, as this may, in some legal systems, give rise to criminal liability for the unlawful discharge of hazardous substances or other crimes.

Another scenario concerns the potential liability of companies whose activities, as highlighted in the literature, may contribute to depriving communities located near data centers of access to water, particularly where such facilities are established in areas already affected by water scarcity (Barnett-Itzhaki, 2026, p. 3 and p. 6).

2.3 Energy Consumption Associated with Data Center Operations and Emissions Released into the Surrounding Environment

Data centers require substantial amounts of energy (International Energy Agency, 2025, p. 9 and p. 55 *et seq.*; Commins and Irion, 2025, p. 2; Shehabi, Smith, Hubbard, Newkirk, Lei, Siddik, Holecek, Koomey, Masanet, and Sartor, 2024, p. 6). Nevertheless, some estimates suggest that data centers currently account for a relatively limited share of global electricity consumption (Falk et al., 2026, p. 1;

International Energy Agency, 2026, p. 13). Although this percentage may increase in the coming years, it would nonetheless remain lower than that associated with many other industrial activities (Spencer and Singh, 2024).

However, the use of a considerable quantity of energy and the type of energy used is associated with higher emissions (Gabbatiss, 2025). In this regard, data centers may rely on electricity supplied through the national grid and may become progressively cleaner as States advance decarbonization policies, where such policies are effectively implemented (Gabbatiss, 2025).

A second possibility involves the use of "captive" energy sources built specifically to supply individual facilities, such as solar panels, small nuclear reactors, or gas turbines (Gabbatiss, 2025). At the same time, concerns have been raised that the expansion of data centers may be used to justify the prolonged reliance on fossil fuels, thereby "locking in" a future characterized by elevated emissions levels (O'Leary, 2025).

According to some studies, coal remains one of the largest sources of electricity supplying data centers globally, largely due to the significant number of facilities located in China. Under current projections, coal could account for approximately 20% of global data center electricity supply by 2030 (International Energy Agency, 2026, p. 50; Qin and Myllyvirta, 2025).

However, these estimates should be interpreted with caution, as recent studies have highlighted China's expansion of renewable energy capacity while also noting that electricity consumption by Chinese data centers currently represents only a small fraction of the country's overall electricity demand (Peters, 2026).

In any case, fossil fuels are estimated to provide nearly 60% of the electricity consumed by data centers, whereas renewable sources account for approximately 27% (Gamazaychikov and Luccioni, 2025; International Energy Agency, 2025, p. 86).

Nonetheless, future projections indicate an increase in the use of clean energy sources and a gradual reduction in reliance on fossil fuels (Gabbatiss, 2025), although it remains difficult to envisage a scenario in which data centers are powered exclusively by renewable energy sources (Gamazaychikov and Luccioni, 2025).

In this regard, in certain areas, such as the Po Valley in Italy, pollution levels are already particularly high due both to the geographical characteristics of the territory and to industrial activity (European Environment Agency, 2025).

Recent news has suggested that Northern Italy may become a major hub for data centers (Savojardo, 2026). From the perspective of environmental and public health protection, however, it becomes necessary to determine whether emissions generated by data centers are in fact capable of causing harm to the environment and to local populations of a kind that requires law intervention. This aspect, too, may give rise to forms of criminal liability.

3 The Main Criminal Law Risks

The phenomena briefly outlined above make it possible to identify a number of areas that companies and individuals involved in the lifecycle of a data center should take into consideration in order to avoid potential forms of criminal liability.

As a preliminary observation, States may or may not provide, from a legislative standpoint, for specific criminal offences sanctioning particular conduct carried out by individuals or companies. Given that some jurisdictions are characterized by lower levels of regulation, including in the field of criminal law, it is possible that certain offences discussed below may not precisely exist in some legal systems, where civil or administrative sanctions may instead apply.

The analysis conducted thus far nevertheless makes it possible to identify, among the various existing forms of exposure, the following principal areas of risk: (a) the health and safety of workers exposed to toxic and polluting materials; (b) the management of waste and/or wastewater and water poisoning; and (c) atmospheric emissions capable of resulting in environmental pollution or environmental disaster.

3.1 Health and Safety of Workers

With regard to workers' health and safety, companies should implement adequate worker protection and risk prevention plans.

For example, where workers are required to handle toxic substances or operate in environments in which hazardous materials are present, they should be provided with appropriate protective equipment.

Such risks are likely to arise particularly during the construction of data centers, maintenance operations, and the disposal of materials and components. Where adequate protective equipment is not provided, workers assigned to such tasks may develop diseases that could have been avoided through the adoption of appropriate safety measures.

These are therefore cases in which the impact of AI is only indirect, as the construction of the data centers required to enable AI systems to operate generates potential risks for workers.

In certain jurisdictions, cases in which the failure to use appropriate protective equipment during the construction of data centers results in death may lead to severe criminal penalties for those responsible for managing workers' health and safety within the company. Even where the failure to implement adequate safety measures results not in death but rather in occupational illness, penalties may nonetheless remain substantial, while the resulting legal, financial, and reputational damage to the company may be considerable.

These situations may occur in practice, for example, where protective equipment is not adequately provided by a company, whether intentionally or, in some cases, negligently, or where workers fail to wear the required equipment, use it only partially, or do not use it correctly.

From a procedural standpoint, it would be necessary to establish a causal link between the specific exposure to toxic materials and the illness that subsequently developed and a (causal) connection between the harm suffered by workers and the actions or omissions of specific individuals, such as company managers who failed to implement adequate safeguards or supervisors who failed to ensure compliance with safety procedures.

However, given the existence of well-established scientific evidence demonstrating that such exposure may lead to the onset of disease, data center operators should, during these particular phases of activity, ensure the conscientious application of the principle of prevention as well as occupational risk-management and worker-safety regulations.

In those cases, in Italy, reference should primarily be made to Legislative Decree No. 81/2008 concerning the protection of health and safety in the workplace, as well as to Legislative Decree No. 152/2006 on environmental protection. In addition, the relevant provisions of the Criminal Code may also apply, including those relating to negligent homicide, negligent personal injury, and other offences depending on the specific circumstances of the case. Comparable worker-protection laws can also be found in other jurisdictions. States that lack such protections, or that provide for them only inadequately, should adopt and strengthen appropriate regulatory frameworks.

Workers' safety concerns are also linked to the possible use of per- and polyfluoroalkyl substances PFAS by certain companies (Hardin, 2026; Perkins, 2025). The risks associated with these substances have now been extensively documented in the scientific literature and, where PFAS are used to coat components or within water-cooling processes, the risk of disease development may increase (Fenton, Ducatman, Boobis, DeWitt, Lau, Ng, Smith, and Roberts, 2021). Recently, in Italy, a first-instance criminal proceeding concluded with findings that PFAS had been discharged into water, soil, and subsoil over a number of years. The defendants were sentenced, on first instance, to several years' imprisonment and ordered to pay millions of euros in compensation within the criminal proceedings, while the civil courts have not yet ruled on compensation claims brought by members of the population who had been exposed to these substances for years (Di Donato and Giovinazzo, 2025).

Although the circumstances of that case and the possible development of illnesses resulting from exposure to toxic materials during, for example, the construction or maintenance of a data center may differ in part, the procedural outcome from a criminal law perspective would likely not differ substantially in the two situations, insofar as both ultimately involve the breach of legal obligations leading to the commission of a criminal offence.

3.2 Management of Waste, Wastewater, and Water Poisoning

The second area of concern arises from the management of waste and wastewater, as well as from the harmful consequences that the discharge of such substances into water sources may have for both the environment and human health.

On the one hand, it is evident that water used for cooling purposes in data centers does not become inherently hazardous in the same manner as substances such as cyanide or other highly toxic chemicals. On the other hand, depending on the cooling techniques employed within data centers, water may nonetheless come into contact with heavy metals, PFAS, or other toxic substances (Hardin, 2026).

A first issue concerns the possibility of preventing such contact altogether. However, where this is not feasible due to the specific cooling methods adopted, a number of criminal law considerations arise in relation to pathological scenarios that may occur in practice.

Once water has come into contact with such substances, many legal systems may classify it as wastewater, thereby subjecting it to specific disposal procedures and sanctions (Italian Environmental Code, 2006, Article 137). Certain jurisdictions encourage water recycling and the reuse of treated wastewater, but only where the relevant purification processes have been properly carried out (Italian Environmental Code, 2006, Article 99).

The use or discharge of contaminated water, or water that has come into contact with heavy metals, may cause serious harm to both the environment and the health of individuals living in surrounding areas. Consequently, failure to comply with the applicable procedures governing disposal and/or reuse may constitute a criminal offence or, in some cases, an administrative violation. In many jurisdictions, regulatory inspections relating to such conduct can result in convictions, including the imposition of significant penalties.

Another issue that has arisen in cases involving the discharge of toxic substances or wastewater into water sources concerns the offence of water poisoning. Penalties vary considerably across jurisdictions. Some States, such as Spain, provide for penalties ranging from two to six years' imprisonment, while others, such as Italy, prescribe imprisonment of no less than fifteen years, extending to life imprisonment where death results. Other jurisdictions, such as Germany, provide for penalties ranging from one to ten years' imprisonment while France applies two years' imprisonment and a fine of EUR 75,000 (Spanish Criminal Code, 1995, Article 365; Italian Criminal Code, 1930, Article 439; German Criminal Code, 1998, Articles 314 and 330a; French Environmental Code, 2000, Article L216-6).

In any event, considering the large quantities of water required by data centers and the consequent potential for discharge into water sources, it may reasonably be assumed that, in cases involving charges of water poisoning, any sentence imposed would be unlikely to correspond to the minimum penalty.

3.3 Energy Consumption and Emissions Released into the Surrounding Environment

In the context of emissions, recent policy plans indicate an intention to reduce pollution levels in the future (European Data Centre Association, 2026, p. 35 and p. 39). However, scholars and activists emphasize that attention should be paid less to declarations of intent and more to concrete action. An author stated that «*there is no point trying to limit emissions or fix climate change*» (Joshi, 2025), while others recognized that «*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*» (Commins and Irion, 2025, p. 33). Building on this latter perspective, which is particularly relevant to criminal law, where it is established that the activities of a specific data center generate polluting atmospheric emissions, various forms of criminal liability may arise.

In certain jurisdictions, both senior corporate officers and the company itself may be held liable for offences relating to environmental pollution or environmental disaster. In Italy, the penalties applicable to the basic forms of these offences range from a minimum of two years' imprisonment in cases of environmental pollution to a maximum of fifteen years' imprisonment in cases of environmental disaster (Italian Criminal Code, 1930, Articles 452-*bis* and 452-*quater*).

4 Conclusion

From the perspective of environmental impact and resource consumption, the phenomenon of data centers undoubtedly raises significant concerns. Current levels of consumption are already substantial, and projections indicate that they are likely to increase further in the coming years (International Energy Agency, 2026, pp. 10–11).

Such developments clearly require effective regulatory responses, whether through administrative regulation or civil law. However, where these frameworks prove ineffective, criminal law may legitimately operate as an *ultima ratio*. Its intervention should therefore remain proportionate and confined to situations in which other legal remedies have failed to ensure adequate protection.

In this respect, there appears to be no immediate need for the creation of entirely new criminal offences specifically targeting data centers. Existing legal systems, provided they already include offences relating to workers' safety, environmental pollution, waste management, etc., appear capable of addressing the potentially unlawful conduct that may arise in this field.

Companies involved in the construction, operation, and maintenance of data centers must therefore be aware of the risks that their activities may pose to human health and safety, including those affecting workers, as well as to the environment. Understanding these risks represents the first necessary step toward their prevention. However, awareness alone is not sufficient.

Accordingly, concrete strategies should be developed to reduce environmental impact and improve compliance practices, in line with the principles of environmental (criminal) law outlined above. In this context, criminal law, together with previous cases resulting in convictions, may continue to perform an important deterrent function.

Finally, further research on this topic is needed. Such studies should focus separately on each of the three key areas identified: workers' health and safety, water-related impacts, and the impact of energy consumption and air emissions. Moreover, these studies should include an in-depth analysis of the legal framework of each State concerned, given that national regulations differ from one jurisdiction to another.

The practical value of such research becomes particularly evident in light of the transnational nature of data center operations. Indeed, an analysis based solely on the legal framework of a single State may not be sufficient to ensure compliance with the regulatory requirements applicable in other national jurisdictions. Therefore, comparative and jurisdiction-specific studies would provide a more comprehensive understanding of the legal obligations and risks associated with the construction and operation of data centers across different legal systems.

Declarations

The author certifies that he has no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

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