Urban Planning
2026 • Volume 11 • Article 12612
https://doi.org/10.17645/up.12612

cogitatio

ARTICLE

Open Access Journal

Computing Corridor or Ecological Cost Conveyor? Regional Equity in China's East-Data-West-Computing Project

Haifeng Deng and Yuchen He

School of Law, Tsinghua University, China

Correspondence: Haifeng Deng (denghf@tsinghua.edu.cn)

Submitted: 20 April 2026 **Accepted:** 14 September 2026 **Published:** 11 November 2026

Issue: This article is part of the issue "Digitalisation and (Un)Sustainability: Assessing Digital Waste and Material Pollution in the City" edited by Letizia Chiappini (University of Twente / NIAS-KNAW), Valeria Ferrari (Universidad Complutense de Madrid), and Athanasios Votsis (University of Twente), fully open access at https://doi.org/10.17645/up.i531

Abstract

Over the past decade, advances in artificial intelligence and related digital technologies have increased demand for computing power. Because the artificial intelligence sector relies heavily on electricity, land, and water, its resource footprint has raised growing concerns regarding pressures on environmental carrying capacity and infrastructure resilience. In response, China launched the East-Data-West-Computing Project in 2020. With eight national computing hubs designated, the project seeks to redirect both large-scale data center clusters and latency-tolerant computing tasks from eastern regions, where demand is concentrated, to central and western China. It aims to ease eastern capacity constraints by reallocating infrastructure and workloads, but it may also reshape the geographic distribution of ecological costs within China, potentially intensifying pressures in central and western regions. Such a pattern may emerge because ecological costs remain insufficiently visible under existing project-by-project assessment frameworks, while efficiency targets are more readily translated into enforceable metrics than equity and coordination objectives. As a result, central and western regions may face growing belated ecological risks, together with resource and fiscal bottlenecks, while the benefits they receive may not be commensurate with the responsibilities they bear. If this mismatch persists, central and western regions may get stuck in less sustainable development paths, which would reinforce development disparities between eastern and western China. To address this challenge, this article proposes a three-pronged institutional framework: MRV-based ecological cost accounting with interregional compensation and benefit-sharing mechanisms; adaptive governance supported by monitoring, disclosure, and participation that enables periodic adjustment; and technological innovation as a transitional measure to reduce unit-level impacts.

Keywords

China; East-Data-West-Computing Project; ecological cost; regional equity; sustainable digital transition; strategic risk

© 2026 by the author(s), licensed under a Creative Commons Attribution 4.0 International License (CC BY).

1. Introduction

Globally, emerging digital technologies, particularly artificial intelligence, have accelerated the expansion of the digital industry. However, this expansion remains dependent on physical infrastructures and resource inputs, including, but not limited to, electricity, land, and water resources (Meige et al., 2026). The ecological footprint of the digital industry has increasingly been recognized as a factor that may hinder urban development by placing pressure on environmental carrying capacity and infrastructure resilience. In China, the conflict between rapidly growing demand for computing power and uneven distribution of available resources has become increasingly salient.

In 2025, China's computing centers consumed 170 TWh of electricity, accounting for 1.6% of national electricity consumption (Liao, 2026). However, the spatial distribution of computing demand and the siting of computing infrastructure do not align well with regional natural resource endowments and power supply. Eastern China has a more developed digital industry and has greater demand for computing power, but further expansion of its digital infrastructure is restricted due to binding constraints such as limited land and strained electricity supply (L. Wang et al., 2025). To alleviate these constraints, China has implemented the East-Data-West-Computing (*Dong Shu Xi Suan*) Project since 2020 (National Development and Reform Commission et al., 2020).

In terms of infrastructure, the project promotes the relocation of a substantial share of data centers to central and western regions, which have advantages in energy availability, land resources, and cooler climates. As for computational allocation, the project designates eight national computing hubs (see Figure 1) to establish

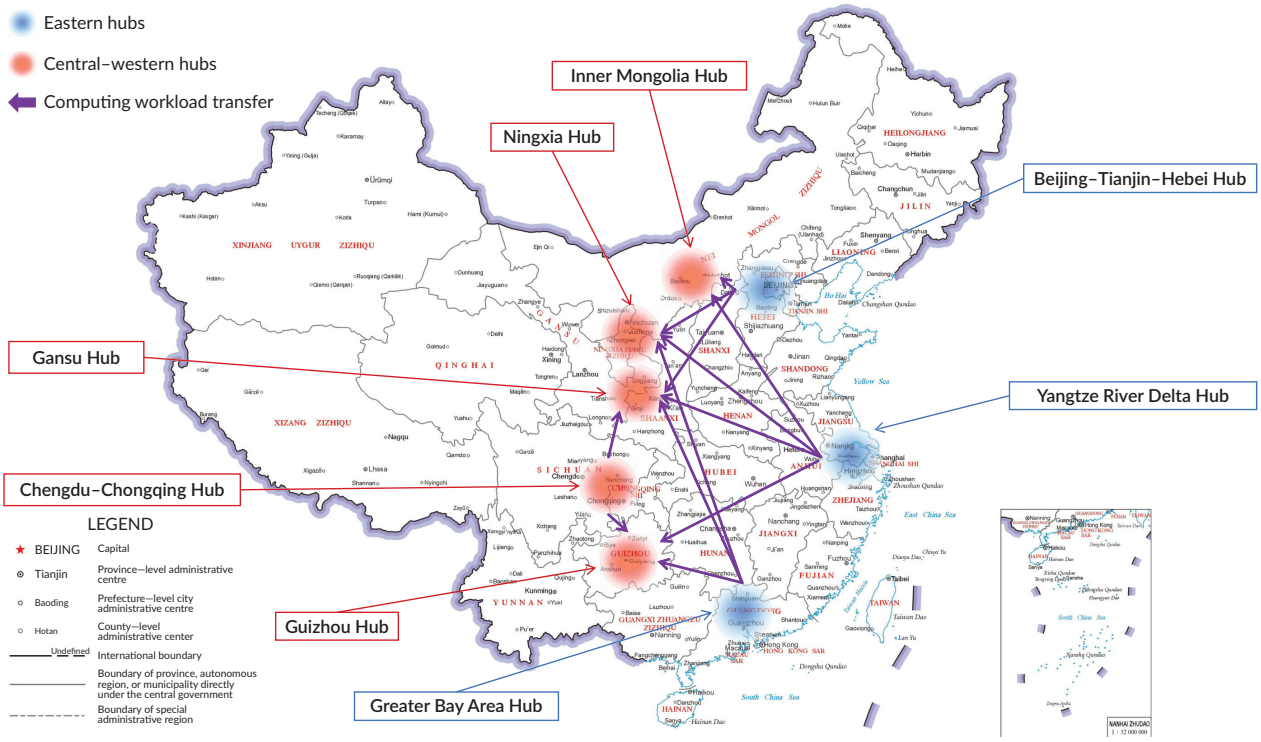


Figure 1. Schematic spatial distribution of the eight national computing hubs. Note: The approval number of the map is Jing Shen Zi (2026) G No. 2456.

a mechanism that coordinates computing resources across regions. Each hub is designed to serve regional computing demand, while hubs in central and western China take on additional tasks transferred from the east.

Under this mechanism, computing tasks are classified and allocated across the eight national hubs. Specifically, latency-sensitive computing tasks generated in eastern regions remain primarily concentrated in eastern hubs located near major user markets, whereas latency-tolerant tasks, which account for a larger share of overall computing demand, are increasingly allocated to hubs in central and western regions (National Development and Reform Commission et al., 2021a, 2023).

This combination of infrastructure agglomeration and task allocation is reshaping the spatial organization of computing capacity in China. Current developments indicate that computing workloads are increasingly transferred from east to west, while computing infrastructure is increasingly being deployed in central and western regions. These shifts raise the problem that the ecological footprint associated with China's digital development may become more and more concentrated in central and western regions as computing infrastructure expands. Such a spatial pattern may interact with existing spatial asymmetries in China's urbanization and regional development, as eastern regions continue to concentrate economic activity and high-value digital functions, while central and western regions may, in some cases, bear a larger share of resource and infrastructure burdens. In this context, it is urgent to consider whether central and western regions can earn benefits and institutional support commensurate with the resources committed and ecological responsibilities associated with hosting computing infrastructure.

In fact, concerns about environmental justice associated with data center development are not unique to China. Rather, they represent a shared challenge arising from the global expansion of digital infrastructure in the era of artificial intelligence. International scholarship has increasingly examined data center expansion from the perspective of justice, focusing on its reliance on energy and natural resources and on the potential redistribution of associated ecological risks across regions (Brodie, 2023; Edwards et al., 2025). However, existing Chinese scholarship on the East-Data-West-Computing Project has largely focused on issues such as overall ecological benefits, hub allocation, and industrial synergy effects (Duan et al., 2025; Y. K. Wang, 2024; Zhang et al., 2025). Although some studies have examined how the project may reshape the distribution of ecological costs across regions, their analyses have primarily focused on identifying the spatial transfer of carbon emissions and its potential implications for regional inequality, without sufficiently exploring the underlying legal and institutional mechanisms that may give rise to these inequalities (Guo et al., 2025; Zhou et al., 2026).

Against this background, this article examines the potential risks of less sustainable development that may arise from the implementation of the East-Data-West-Computing Project initiative in central and western China. It seeks to answer the following questions: How the spatial restructuring of computing resources, driven by the East-Data-West-Computing Project, may produce or reinforce a separation between where digital value is captured and where ecological costs are incurred, and how such a separation may expose central and western regions to uneven and less sustainable development paths. This article first identifies the risks associated with the project's spatial restructuring, then examines the mechanisms behind the separation between digital value capture and ecological cost bearing, and finally discusses possible institutional responses to promote a more equitable and sustainable digital transition.

2. Methodology

Based on an institutional analysis approach, this article combines policy document analysis with illustrative case evidence. Relevant policy materials were identified in the PKULaw legal database using the keywords "Dong Shu Xi Suan" (East-Data-West-Computing) and "Quanguo Yitihua Suanli Wangluo" (national integrated computing power network). This article finally selected seven relevant central government policy documents issued since 2020 (see Table 1) to examine their policy objectives and institutional arrangements. In addition, using the same keywords, this article collected local policy documents, official government sources, media reports, and journal articles to examine the potential implications of the project's implementation. For illustrative case analysis, this article mainly focuses on Guizhou, Gansu, Ningxia, and Inner Mongolia, which host central and western computing hubs designed to accommodate computing workloads transferred from demand centers in the east.

Table 1. Main policy documents.

	Policy Document	Document number
1	Guiding Opinions on Accelerating the Construction of a National Integrated Big Data Center Collaborative Innovation System	Fagai Gaoke [2020] No. 1922
2	Implementation Plan for the Computing Hubs Under the National Integrated Big Data Center Collaborative Innovation System	Fagai Gaoke [2021] No. 709
3	Reply Regarding the Approval for Ningxia Hui Autonomous Region to Launch the Construction of a National Computing Hub Under the National Integrated Computing Power Network	Fagai Gaoke [2021] No. 1841
4	Reply Regarding the Approval for Beijing–Tianjin–Hebei Region to Launch the Construction of a National Computing Hub Under the National Integrated Computing Power Network	Fagai Gaoke [2022] No. 212
5	Reply Regarding the Approval for Chengdu–Chongqing Region to Launch the Construction of a National Computing Hub Under the National Integrated Computing Power Network	Fagai Gaoke [2022] No. 88
6	Reply Regarding the Approval for Yangtze River Delta Region to Launch the Construction of a National Computing Hub Under the National Integrated Computing Power Network	Fagai Gaoke [2022] No. 211
7	Opinions on Further Implementing the East-Data-West-Computing Project and Accelerating the Development of a National Integrated Computing Network	Fagai Shuju [2023] No. 1779

3. From Spatial Reallocation to Risks of Less Sustainable Development

3.1. The Computing Corridor as an Ecological Cost Conveyor

With the implementation of the East-Data-West-Computing Project, a preliminary spatial division of functions has emerged between eastern regions with strong computing demand and central and western regions, which are gradually serving as computing supply hubs ("Dong Shu Xi," 2025). National narratives that emphasize aggregate gains tend to obscure a parallel process, namely the intra-national redistribution of ecological costs generated by the expansion of the digital industry. As data centers expand, ecological costs

associated with digital development may increasingly fall on central and western regions. If existing patterns persist, the computing corridor may become an ecological cost conveyor.

In existing literature, this ecological perspective differs from the dominant evaluative tendency. Most scholars focus on national-scale trends and long-term efficiencies, emphasizing the advantages of central and western regions for data center development, including their renewable-energy endowments and climatic conditions. As such, the East-Data-West-Computing Project is often regarded as an institutional arrangement that can reduce overall ecological pressure across the country (Zhang et al., 2025). Although this assessment captures part of the picture, it overlooks a crucial point: The use of renewable electricity and advanced technologies does not necessarily eliminate the ecological footprint associated with digital development.

In fact, large-scale data center development can place ecological pressures in multiple areas, including but not limited to biodiversity loss, increased freshwater consumption, and rising carbon emissions. From the perspective of biodiversity, more and more data centers are equipped with dedicated renewable energy facilities designed to meet their electricity demand ("Quanguo shouge shujuzhongxin," 2025; "Neimenggu shuniu dazao," 2024). The expansion of such infrastructure may fragment habitats of wild fauna and flora, increase collision-related wildlife mortality caused by renewable energy installations, and reduce the productivity of plant communities in affected areas (Katzner et al., 2025; OECD, 2024; Zhao et al., 2025). Regarding water use, data center operations still rely heavily on high-quality freshwater to ensure stable equipment performance, even though cooler climates in some areas can moderately reduce data centers' cooling demand. Total freshwater consumption is likely to rise as computing capacity expands (P. F. Li et al., 2025). In terms of carbon emissions, the expansion of computing infrastructure may continue to increase local carbon pressures even as renewable electricity becomes more widely integrated into data center operations, because growth in computing demand can offset gains from green energy technologies. Under a relatively optimistic scenario, technological improvements may enable some hub cities to pass the turning point and eventually reduce emissions. Nevertheless, existing evidence suggests that many non-hub cities may continue to witness steady growth in carbon emissions as computing infrastructure expands (F. F. Mao et al., 2024).

Accordingly, the East-Data-West-Computing Project may lead to a growing concentration of ecological pressures in particular regions. Under this spatial restructuring, potential ecological burdens associated with data center expansion may not manifest as immediate and easily attributable impacts. Since the East-Data-West-Computing Project is still at a relatively early stage, representative Chinese cases of long-term cumulative effects remain limited. However, mature international cases can provide useful references.

Loudoun County, Virginia, a major hub in the United States that serves for data center activity and digital computing demand, has witnessed the development of roughly 250 data centers over two decades. Although reviews of individual projects did not flag electricity demand as a problem, the cumulative expansion of data centers placed substantial stress on the regional grid. Utilities responded to rising demands of data centers by postponing or canceling the retirement of several fossil-fueled power plants, which prolonged greenhouse gas emissions and air pollution that otherwise could have declined over time (Turner, 2026).

In short, a computing corridor turns out to be an ecological burden conveyor. The following ecological pressures may manifest in biodiversity loss, freshwater depletion, and carbon emissions, which could accumulate into broader ecological risks. Recognizing this cumulative process, the next question is how escalating ecological risks may constrain the long-term development of central and western China.

3.2. Pathways to Less Sustainability and Uneven Development

For central and western regions, the potential concentration of ecological pressures associated with the expansion of data centers may extend beyond environmental impacts, creating additional fiscal and governance demands on local governments. As these regions become major locations for computing infrastructure under the East-Data-West-Computing Project, local governments may need to devote additional fiscal resources and governance capacity to managing the associated ecological footprint. Such demands may be particularly challenging for some central and western regions, where fiscal resources and governance capacity have historically been more constrained than in eastern regions. If these additional efforts do not lead to commensurate gains, central and western regions may face greater obstacles to achieving sustainable and balanced development.

A major source of additional fiscal pressure is the increasing need for infrastructure to support the expansion of data centers. As computing capacity grows, local jurisdictions hosting data centers may need to construct, expand, or upgrade supplying systems to provide and distribute electricity, water, and other resources at the required scale. This need for infrastructure may include expanding power grid capacity, upgrading water supply and pipeline networks, and developing complementary facilities such as roads. Meeting these additional demands may require substantial upfront investment, as well as long-term operation and maintenance expenditures, thereby increasing fiscal pressures on central and western regions. For instance, Qingyang, a key node city of the East-Data-West-Computing Project in Gansu province, invested 488 million yuan in 2024 to support the construction of the data center industrial park and raised 328 million yuan in various forms of funding to construct roads, pipe networks, and other public infrastructure for its data center industrial park ("Guanyu Qingyangshi 2024," 2025).

Another source of pressure is the additional local governance capacity required to address potential ecological impacts due to the expansion of data centers. Apart from infrastructure development, local governments may need to strengthen environmental monitoring and risk response strategies to manage potential ecological impacts arising from large-scale data center deployment. For example, the feasibility study report of the Zhongwei Digital Information Industry Development Zone in Ningxia Hui Autonomous Region explicitly attaches great importance to environmental monitoring, pollution control, and risk management during the development process, including ecological monitoring, solid-waste management, and specialized e-waste treatment ("Feasibility study report," 2025). Implementing such monitoring and response strategies may require dedicated funding for monitoring infrastructure, trained personnel, and technical platforms to support coordinated environmental risk management.

These additional fiscal and governance demands would not necessarily constitute a long-term burden if central and western regions could obtain benefits commensurate with their expanded ecological and governance responsibilities. However, available evidence suggests that such gains may remain limited in two important respects.

For one thing, local governments in central and western China need to consider whether the economic benefits accruing to their regions are commensurate with the scale of local investment in the East-Data-West-Computing Project. In some regions, the economic benefits generated by computing industry may not fully correspond to the scale of investment flows. One indication of such benefits is fiscal revenue generated for local governments. For example, in Ulanqab, Inner Mongolia Autonomous Region, investment in the computing-power industry reached 4.677 billion yuan in the first half of 2024, whereas the tax revenue deposited into the local treasury was only 94.33 million yuan (Hao, 2024). This contrast suggests that local fiscal returns may not necessarily correspond to the scale of investment in the computing industry attracted to the region.

Beyond immediate fiscal returns, another question concerns whether data center development can generate broader spillover effects across the digital economy and strengthen the economic prospects of central and western regions. However, in terms of the growth rates of the digital industry across different regions, the eastern region recorded 6.5%, the central region 4.2%, and the western region only 0.8% ("2024 nian shuzi," 2025). There remains a significant disparity between the eastern region and the central and western regions in digital industry development.

At the same time, local governments may provide substantial incentives to attract data center investment, which may reduce immediate fiscal revenues they receive from land and electricity transactions. For example, Guian New Area in Guizhou Province provides eligible large data centers with a stable preferential electricity tariff of 0.35 yuan per kWh ("Dashuju chanye huiqi," 2022). Similarly, Qingyang, Gansu Province, has formalized preferential land-pricing policies for data centers. The government has set a relatively low starting price for land transfer in digital industry parks, at around 360,000 yuan per mu, which is equivalent to approximately 540 yuan per square meter. In addition, it provides financial incentives for some demonstration projects under the East-Data-West-Computing Project initiative once they complete one-third of their planned investment (General Office of the Qingyang Municipal People's Government, 2022). Such incentives do not always constitute direct fiscal expenditures, but they may reduce the immediate fiscal returns that local governments obtain from hosting data center projects.

Beyond fiscal returns, another important dimension concerns whether central and western regions can obtain sufficient talent and technological resources to support long-term digital development. Local governments in central and western regions seek to strengthen their capacity to attract high-skilled talent and advanced technologies by investing in training systems. For example, Ulanqab is building industry-education partnerships and training bases for the data center sector, including a joint training program with Huawei Cloud under a government-university-enterprise model (S. Cui, 2024).

However, employment outcomes also suggest a potential gap between the scale of data center investment and direct local benefits. For instance, four enterprises in Ulanqab signed investment agreements for intelligent-computing-center projects with a total investment of 31.9 billion yuan. These projects are expected to provide approximately 285,000 server racks but created only about 800 jobs after commissioning (J. F. Cui, 2026).

In addition, new jobs created by data center construction are mostly concentrated in positions with low skill requirements and short employment terms, such as security, daily operations and maintenance, and cleaning

services, while fewer opportunities are created for highly skilled workers (Nguyen & Green, 2025). Therefore, although central and western regions have been actively recruiting talent, they have not yet reversed the longstanding concentration of digital talent and innovation resources in eastern China. At present, about 70% of digital technology talent is concentrated in eastern China, where stronger research institutions and industrial ecosystems may contribute to attracting and retaining skilled workers. By contrast, less than 20% of digital technology talent returns to western regions due to constraints such as limited innovation funding and technology exchange platforms (X. Y. Yang & Liu, 2026). These patterns suggest that the relocation of computing infrastructure does not necessarily result in a parallel shift in high-value digital capabilities or innovation capacity.

Taken together, existing evidence indicates a potential structural imbalance. Central and western regions may shoulder increasing ecological and governance responsibilities associated with computing infrastructure development, while failing to receive commensurate economic returns and talent inflows. If this mismatch between increasing responsibilities and limited returns persists, central and western regions may face greater constraints in improving their relative position in future interregional development.

Table 2 provides a consolidated summary of the key quantitative evidence presented in Sections 1 through 3. It covers data center energy consumption, regional digital industry growth rate, digital talent retention, economic input, and local benefits. These figures reveal a potential mismatch between the responsibilities of central and western regions and the benefits they receive.

Table 2. Key quantitative evidence.

Dimension	Key quantitative evidence
China's data center energy consumption	170 TWh; 1.6% of national electricity consumption (2025)
Regional digital industry growth rate	Eastern regions 6.5%; central regions 4.2%; western regions 0.8% (2024)
Digital talent retention	70% of digital technology talent concentrated in eastern China (2022) Less than 20% of talent return to western regions (2024)
Economic input and local benefits	328 million yuan for public infrastructure construction of data-center industrial park (Qingyang, Gansu, 2024) Investment of 4.677 billion yuan; local treasury tax revenue of 94.33 million yuan (Ulanqab, Inner Mongolia, H1 2024) Investment of 31.9 billion yuan; 800 new jobs (Ulanqab, Inner Mongolia, 2026)

4. Invisible Ecological Costs and Metric-Biased Governance

To interpret the dynamics described in Section 3, a further question arises: Why might central and western regions, despite bearing a growing share of potential ecological pressures, face challenges in obtaining benefits commensurate with the costs they incur? At least two factors help explain this mismatch. First, ecological costs may remain insufficiently visible in the absence of a dedicated mechanism for identification and accounting. Second, distributive-justice objectives have not been translated into operational metrics and procedures as enforceable as efficiency-oriented indicators.

To identify the ecological risks and costs resulting from these cumulative effects, governance typically requires consistent monitoring standards, continuous tracking, and robust regional baseline data. However, traditional governance often operates in a decentralized, project-by-project way, which can undermine a systemic perspective and make it difficult to objectively assess cumulative ecological risks and costs. Consequently, without effective mechanisms specifically designed to identify ecological costs, the costs may remain partially visible and difficult to incorporate into decision-making in time. Instead, they tend to accumulate over time and become noticeable only when ecosystems approach critical thresholds.

Within China's current institutional framework, environmental impact assessment has become relatively well established at both the project and planning levels. Each system operates at its own scale, focusing on individual projects and plans within a defined spatial scope. However, these regimes are constrained by limitations in assessment scope and temporal scale. They struggle to capture cumulative impacts that unfold over time and accumulate as the number of projects grows, and they are also limited in addressing the long-term and synergistic effects that emerge through the accumulation of multiple policies and development activities. Even when all projects or related plans in the same area complete their respective environmental impact assessments, their combined effects may still accumulate and generate diffuse risks that remain difficult to detect before they approach critical thresholds (Y. N. Li & Zhang, 2022). Overall, these regimes remain inadequate for identifying and accounting for ecological costs and are therefore not fully equipped to support the sustainable governance of the East-Data-West-Computing Project.

Therefore, as long as cumulative ecological costs remain insufficiently visible due to the lack of dedicated monitoring mechanisms, governance attention may gravitate toward industrial expansion and macro-level performance indicators. Meanwhile, these hidden costs may impose additional fiscal and governance burdens due to higher spending on public systems, enforcement, and risk management. In today's institutional setting, central and western regions may bear a substantial share of these hidden costs, particularly when they are not incorporated into broader mechanisms for interregional accounting and coordination.

On a broader scale, efficiency goals are easier to embed in governance and performance-assessment frameworks, as they are more readily translated into enforceable indicators. This, in turn, can direct governance resources toward objectives that can be quantified and monitored. Even though the East-Data-West-Computing Project sets out multiple objectives, such as coordination across regions and sectors, low-carbon development, security and reliability, universal and user-friendly services, and efficient and high-quality development (National Development and Reform Commission et al., 2020, 2023), their institutional translation creates uneven enforceability across goals. In practice, efficiency objectives are translated into concrete metrics, whereas justice and coordination objectives usually remain at the level of general principles.

In the approval letters from the central government for establishing national computing hubs, the state explicitly elevates production efficiency metrics, such as energy efficiency performance and average rack occupancy rates, into core assessment criteria. For instance, several approval letters require data centers within each hub to maintain an average rack occupancy rate of at least 65% and to keep power usage effectiveness at or below 1.25 (National Development and Reform Commission et al., 2021b, 2022a, 2022b, 2022c). This indicates that efficiency goals have been institutionalized as quantifiable, accountability-oriented metrics, which could be subsequently implemented and enforced by subnational governments.

By contrast, objectives related to interregional distributive justice and balanced development have not been translated into performance metrics or operational procedures as specific and enforceable as efficiency-oriented indicators. For example, central policies call for removing regional barriers, building a nationally integrated computing network, and promoting coordination across regions, agencies, and municipal tiers through collaboration between eastern demand centers and central-western supply regions. However, apart from the general requirement for eastern regions to pair up with central and western regions, these documents provide relatively few concrete rules for how such coordination should operate in practice (National Development and Reform Commission et al., 2023).

Under these conditions, the administrative preferences for clear metrics and standardized procedures may lead local governments to focus disproportionately on efficiency indicators in the construction and operation of national computing hubs, with governance resources allocated accordingly. By contrast, interregional fairness and coordinated development are more difficult to identify, quantify, and operationalize through existing assessment frameworks, and therefore tend to recede in the hierarchy of governance priorities. If this imbalance in operational force persists, the mismatch described above may become increasingly difficult to correct. In turn, returns in the central and western regions may fail to keep pace with rising expenditures, increasing the risk that these regions would face greater constraints in pursuing sustainable and balanced development over the long term.

5. Toward a Sustainable Digital Transition

To explore a more just and sustainable path for China's digital transition, we propose an institutional improvement framework consisting of three dimensions. First, ecological cost accounting and interregional ecological cost-sharing mechanisms should be established. Second, adaptive governance should be supported by data monitoring, information disclosure and public participation procedures. Third, technological innovation should be leveraged to reduce ecological pressures during the transition. More specifically, ecological cost accounting and interregional ecological cost-sharing mechanisms aim to incorporate ecological costs into governance processes and, on this basis, promote a more balanced allocation of cross-regional responsibilities and benefits. Adaptive governance mechanisms rely on information feedback and procedural adjustment to respond to changing circumstances and ensure the continued effectiveness of relevant institutional arrangements. Technological innovation, in turn, primarily serves as a transitional instrument, creating additional time and governance space for advancing the first two institutional reforms.

5.1. Ecological Cost Accounting and Interregional Settlement

An effective approach to systematically accounting for ecological costs and promoting a fairer distribution of costs and benefits across regions should include two interconnected mechanisms. One is an ecological cost accounting system, and the other is an interregional ecological cost-sharing system. The former addresses how ecological costs are identified and quantified, while the latter addresses how costs and benefits can be allocated more justly across regions.

The main function of an ecological cost accounting system is to translate diffuse ecological pressures into indicators that can be measured, compared, and audited over time. The indicator system should cover multiple

dimensions, at least including electricity use, land use, biodiversity and habitat integrity, water resources, and carbon emissions. For operational design, the system can build on established practices in climate governance and adopt an MRV framework.

An MRV mechanism is organized around three linked components: measurement, reporting, and verification. Measurement tracks ecological conditions during and after development activities, namely, generating quantified indicators of changes in ecological conditions through continuous monitoring. Reporting concerns how data are presented, that is, how to organize and compile data into standardized reports under a unified methodology, so that the information remains comparable, intelligible, and publicly accessible. Verification refers to independent third-party review of reports for accuracy, completeness, and compliance, thereby procedurally reducing discretionary manipulation of data (World Resources Institute, 2016). Taken together, these three components provide a stable and reliable cost-accounting mechanism.

However, ecological cost accounting only makes costs visible. It does not determine, on its own, who should bear them or how benefits should be shared. To narrow this institutional gap, the framework also requires an interregional ecological cost-sharing system. To distinguish payment obligations triggered by different causes and reflect diverse justice claims, the system should incorporate at least two data-based instruments, including an interregional compensation mechanism and a benefit-sharing mechanism.

Among these instruments, an interregional compensation mechanism is designed to ensure that ecological costs are shared more fairly among regions along the computing power supply chain. As noted above, central and western regions may bear greater ecological pressures and higher governance costs while obtaining relatively limited returns. Benefits may fail to fully compensate for these hidden costs, potentially constraining development capacity and increasing risks of resource over-exploitation and governance pressure. Therefore, once hidden ecological costs are quantified and made transparent, institutionalized transfer-payment mechanisms can provide a basis for rebalancing the distribution of costs and benefits across regions, mitigating inequities, and reducing ecological and developmental risks faced by central and western regions.

In fact, such an approach has precedents in China. The 2024 establishment of a horizontal ecological protection compensation mechanism exemplifies how cross-regional mismatches between beneficiaries and cost bearers can be addressed through institutionalized transfer mechanisms, with beneficiary regions compensating regions that bear ecological protection responsibilities (State Council of the People's Republic of China, 2024). A similar logic could be applied to the East-Data-West-Computing Project, where regions that capture digital benefits could help compensate regions that bear ecological costs, thereby better aligning the distribution of digital gains with the ecological responsibilities associated with computing infrastructure.

In terms of stakeholders, eastern local governments could serve as primary compensating parties, while corresponding central and western local governments, which maintain stable computing power supply links with the east, could be the main recipients. Eastern local governments can mobilize financial and in-kind resources from local beneficiaries such as artificial intelligence enterprises. Central and western local governments should then allocate and use these resources in accordance with regulations and ecological and governance needs. The overall level of compensation should be based on quantified ecological costs, while also considering broader distributive and governance considerations. Meanwhile, each eastern region's

payment obligation should be linked to the scale of its benefits or relevant performance indicators to maintain a clear correspondence between benefits and responsibilities.

In addition, a benefit-sharing mechanism that complements interregional compensation could help mitigate the continuous concentration of value added and technological benefits within the digital value chain in eastern regions. By encouraging eastern regions to share a portion of their gains with central and western regions, such a mechanism may contribute to reducing disparities in returns and technological accumulation, thereby lowering the risk that regional imbalance becomes structurally reproduced over time.

China has developed benefit-sharing arrangements in other domains of resource governance, such as genetic resources and traditional knowledge (Department of Ecological Environment of Guangxi Zhuang Autonomous Region, 2021). Along the same lines, the East-Data-West-Computing Project could explore long-term benefit-sharing arrangements between digital infrastructure firms that benefit from computing resource deployment and local governments or communities that bear associated ecological pressures, potentially including monetary compensation and technology cooperation agreements.

5.2. Adaptive Governance

To maintain the effectiveness of the foregoing mechanisms over the long run, the framework also requires external oversight and internal self-correction mechanisms. To this end, the framework can adopt adaptive governance by embedding feedback loops and correction mechanisms within the existing top-down governance architecture. Adaptive governance treats rules as an open, iterative framework. It periodically evaluates how existing rules perform in practice and, based on those assessments, adjusts governance measures on a cyclical basis to better respond to changing real-world needs (Chaffin et al., 2014).

In the context of the East-Data-West-Computing Project, market volatility, shifting ecological constraints, and evolving technological trajectories can all reshape the circumstances of different regions. If governance relies on fixed measures, the supporting institutional arrangements may become increasingly misaligned with real conditions. Accordingly, institutional design and implementation should acknowledge the limits of fixed governance measures and rely on adaptive governance to enable institutional arrangements to adjust as conditions change. Frequent adjustments that follow from this approach do not undermine the authority of the rules; rather, they can enhance their reliability and effectiveness.

At the same time, institutional iteration depends on information that is both sufficient and accurate. Therefore, decision makers should not only keep gathering adequate, reliable scientific information, but also bring relevant actors into deliberation and incorporate their local knowledge into both decision-making and implementation (Dietz et al., 2003). Legally, this requires the establishment of robust systems for data monitoring, information disclosure, and public participation.

Among these components, data monitoring serves as a key source of scientific information. It not only records ecosystem conditions but also provides traceable evidence for the periodic review and adaptive revision of rules. Information disclosure should not only ensure sustained access to key rules and indicators but also reveal the evidence and reasons behind adjustments. This allows the public to understand how rules are developed and why they change, thereby enabling more informed questions and proposals. Built on data monitoring and

information disclosure, public participation has long been recognized as a core institutional arrangement for social oversight and for helping governance actors track and respond to changing conditions (Huitema et al., 2009; Olsson et al., 2008).

In the field of data center governance, the reporting mechanism for the sustainability of data centers established by the European Union in 2024 provides a practical example of the information feedback approach underlying adaptive governance (European Commission, 2024). This institutional practice reflects the principles of information feedback and periodic adjustment emphasized in adaptive governance. For the East-Data-West-Computing Project, similar adaptive governance approaches also deserve further exploration.

5.3. Technological Innovation as a Transitional Measure

Implementing the two institutional reforms outlined above inevitably takes time. If ecological risks associated with computing expansion materialize before effective reform mechanisms are established, some resulting ecological impacts may become difficult to reverse, and later institutional reforms may no longer be able to fully prevent or remedy the resulting losses. Accordingly, given that demand for computing power is likely to continue expanding and resource pressures associated with digital infrastructure may further intensify, government incentives for technological innovation can play an important role in reducing resource inputs per unit of computing output and mitigating environmental disturbance, thereby creating additional time for institutional reforms to take effect.

Growth in aggregate demand and supply for computing power is likely to increase resource demands from actors such as data centers. Technological innovation can reduce resource inputs per unit of computing power and lessen the intensity of the resulting environmental disturbance. For instance, more efficient cooling technologies can reduce water use at individual facilities; more advanced renewable energy utilization and integration technologies can lower the carbon intensity of electricity consumption; and more fine-grained allocation of computing tasks can better align workloads with fluctuations in renewable power supply, which further reduces carbon emissions at the system level.

Therefore, even if technological progress does not alter the underlying growth trajectory, it can buffer and potentially reduce the intensity of concentrated ecological pressures. In turn, this allows institutional refinement and reform to be completed, with extra time afforded for these initiatives. In addition, from the perspective of resource stocks, reductions in resource inputs per unit of computing output and in ecological disturbance intensity could help slow the depletion of natural resources and land use associated with computing infrastructure expansion in central and western regions. This could contribute to preserving greater resource flexibility in central and western regions, providing additional buffers before institutional reforms are fully established and supporting future adjustments in regional development.

Still, technological progress alone is unlikely to eliminate the risk of interregional imbalance between eastern and western China. It may even obscure such risks by making continued expansion appear environmentally benign. By lowering the unit costs of resource use, technological development may lead to larger and more frequent resource appropriation, while also strengthening the legitimacy of such expansion within governance and market narratives (Hertwich, 2005). However, benefits of technological progress may not offset the additional pressure caused by overall expansion; instead, they may actually exacerbate ecological

degradation. To prevent efficiency rhetoric from creating an illusion of benign expansion, technological innovation should be treated as a transitional measure complemented by the first two institutional reforms to make justice-oriented development objectives visible and operational in governance agendas.

6. Conclusion

Under the current institutional framework, East-Data-West-Computing Project may increasingly shift ecological pressures to central and western regions, while more of the benefits generated by the development of the artificial intelligence industry are enjoyed by eastern regions. This potential pattern reflects the limitation of justice-oriented objectives in terms of institutional integration. To address this institutional imbalance, we propose that public authorities should design institutional arrangements that better operationalize justice as a development objective. Specifically, the institutional package has three interlocking components.

First, ecological cost accounting should be linked to settlement through an integrated system, which could quantify multidimensional ecological costs through an MRV cycle, providing an empirical basis for interregional compensation and benefit-sharing mechanisms with stable transfer payment rules. Second, adaptive governance should be employed. Policies should be adjusted in response to multiple stakeholder involvement and continuously updated information, which enables governance measures to track changing conditions more closely. Third, incentives for technological innovation should be used as a transitional measure. By reducing resource inputs and ecological disturbance per unit of computing output, innovation can provide additional time and governance space for the first two institutional reforms to take effect.

If economic gains continue to concentrate in eastern regions, while central and western regions bear most of the ecological burdens without receiving adequate benefits or compensation, then the East-Data-West-Computing Project may appear efficient but will, in the long term, become increasingly unfair and unsustainable. Making ecological burdens visible and institutionally shareable is therefore an important condition for achieving a digital transition that is not merely more efficient, but also more just and durable. For this reason, the East-Data-West-Computing Project requires sustained attention from legal scholars and social scientists concerned with justice and equality in the digital age. Further research should therefore continue to refine methods for ecological cost accounting, mechanisms for interregional settlement, and the legal procedures that allow adaptive and participatory governance to be effective in practice.

Funding

This research was supported by the National Social Science Fund of China (Grant No. 25VHQ003).

Conflict of Interests

The authors declare no conflict of interests.

Data Availability

No primary data were generated for this study. All materials and secondary data used in the analysis are publicly available from the sources cited in the article.

LLMs Disclosure

ChatGPT was used to assist in refining the English of the article.

References

2024 nian shuzi chanye yunxing qingkuang. (2025, March 17). *Ministry of Industry and Information Technology of the People's Republic of China*. https://wap.miit.gov.cn/jgsj/yxj/xxfb/art/2025/art_49031440236d4650823b131173a1794d.html

Brodie, P. (2023). Data infrastructure studies on an unequal planet. *Big Data & Society*, *10*(1). https://doi.org/10.1177/20539517231182402

Chaffin, B. C., Gosnell, H., & Cosens, B. A. (2014). A decade of adaptive governance scholarship: Synthesis and future directions. *Ecology and Society*, *19*(3), Article 56. https://www.jstor.org/stable/26269646

Cui, J. F. (2026, February 9). Wulanchabu: Shuzi jingji zhaoshang xiying kaimenhong. *Ulanqab Municipal People's Government*. https://www.wulanchabu.gov.cn/ysdt/1929163.html

Cui, S. (2024, December 3). Jujiao zhiye jiaoyu shuzihua rencai peiyang: Wulanchabu chengshi yunchanjiao ronghe chuangxin fenghui juxing. *Science and Technology Daily*. https://www.stdaily.com/web/gdxw/2024-12/03/content_267955.html

Dashuju chanye huiqi zhengce zhaibian. (2022, June 15). *Guizhou Provincial Big Data Development Administration*. https://dsj.guizhou.gov.cn/ztzl/lszt/dsjszjjzcxgzl/202206/t20220615_86422497.html

Department of Ecological Environment of Guangxi Zhuang Autonomous Region. (2021). *Guangxi Zhuangzu Zizhiqu shengwu yichuan ziyuan jiqi xiangguan chuantong zhishi huoqu yu huiyi fenxiang guanli banfa (shixing)* (Guihuan Guifan [2021] No. 5). http://sthjj.hechi.gov.cn/xxgk/fdzdgknr/gfxwj/t10354024.shtml

Dietz, T., Ostrom, E., & Stern, P. C. (2003). The struggle to govern the commons. *Science*, *302*(5652), 1907–1912. https://doi.org/10.1126/science.1091015

Dong Shu Xi Suan Sannian: Quyu xietong zenmeyang?. (2025, March 11). *Beijing Information and Telecommunication Association*. https://www.bita.org.cn/newsinfo/8113342.html

Duan, W., Wang, B., & Han, J. (2025). Digital economy reshaping industrial layout: Theoretical mechanism and practice in China. *Nanjing Journal of Social Sciences*, *36*(3), 46–57. https://doi.org/10.15937/j.cnki.issn1001-8263.2025.03.006

Edwards, D., Cooper, Z. G. T., & Hogan, M. (2025). The making of critical data center studies. *Convergence: The International Journal of Research into New Media Technologies*, *31*(2), 429–446. https://doi.org/10.1177/13548565231224157

European Commission. (2024). *Commission delegated regulation (EU) 2024/1364 of 14 March 2024 on the first phase of the establishment of a common Union rating scheme for data centers*. Official Journal of the European Union. https://eur-lex.europa.eu/eli/reg_del/2024/1364/oj

Feasibility study report on the establishment of Ningxia Zhongwei digital information industry development zone (Draft for Public Comments) (Ningxia zhongwei shuzi xinxi chanye kaifaqu sheli kexingxing yanjiu baogao (zhengqiu yijian gao)). (2025). https://www.nxzw.gov.cn/zmhd/yjzj/202512/P020251219422275422615.pdf

General Office of the Qingyang Municipal People's Government. (2022). *Qingyangshi jianshe quanguo yitihua suanli wangluo guojia shuniu jiedian (Gansu·Qingyang) ji Dong Shu Xi Suan gongcheng yaosu baozhang fang'an* (Qingzheng Banda [2022] No. 136). https://zgqingyang.gov.cn/gk/zfxxgk/zfgb35zwgkb/content_19897

Guanyu Qingyangshi 2024 nian caizheng yusuan zhixing qingkuang he 2025 nian quanshi ji shiji caizheng yusuan (cao'an) de baogao. (2025, May 29). *Qingyang Municipal People's Government*. https://zgqingyang.gov.cn/gk/zfxxgk/zfgb35zwgkb/content_27168

Guo, Y. Y., Ye, Y. Y., Wang, C. J., Liu, Z. Q., & Lu, Q. (2025). "Dong Shu Xi Suan" zhanlue beijing xia Zhongguo shuju zhongxin tan paifang kongjian zhuanyi yanjiu. *Geographical Science*, *45*(3), 459–471. https://doi.org/10.13249/j.cnki.sgs.20230568

Hao, Y. T. (2024, September 19). Wulanchabushi yi pengpai suanli dazao jingji gaozhiliang fazhan qiangjin zengzhangji. *CNR News*. https://nm.cnr.cn/hlnmg/20240919/t20240919_526910243.shtml

Hertwich, E. G. (2005). Consumption and the Rebound Effect: An Industrial Ecology Perspective. *Journal of Industrial Ecology*, *9*(1/2), 85–98. https://doi.org/10.1162/1088198054084635

Huitema, D., Mostert, E., Egas, W., Moellenkamp, S., Pahl-Wostl, C., & Yalcin, R. (2009). Adaptive water governance: Assessing the institutional prescriptions of adaptive (co-)management from a governance perspective and defining a research agenda. *Ecology and Society*, *14*(1), Article 26. https://www.jstor.org/stable/26268026

Katzner, T. E., Nelson, D. M., Marques, A. T., Voigt, C. C., Lambertucci, S. A., Rebolo, N., Bernard, E., Diehl, R., & Murgatroyd, M. (2025). Impacts of onshore wind energy production on biodiversity. *Nature Reviews Biodiversity*, *1*(9), 567–580. https://doi.org/10.1038/s44358-025-00078-1

Li, P. F., Yang, J. Y., Islam, M. A., & Ren, S. L. (2025). Making AI less thirsty. *Communications of the ACM*, *68*(7), 54–61. https://doi.org/10.1145/3724499

Li, Y. N., & Zhang, J. (2022). The theoretical justification and improvement path of policy environmental impact assessment. *Academic Journal of Zhongzhou*, *47*(7), 53–62. https://zzxk1979.cn/Uploads/PdfFile/2022-08-29/630c78a25a3a7.pdf

Liao, R. L. (2026, May 29). Qunian quanguo suanli zhongxin zong yongdianliang 1700 yi qianwashi. *National Energy Administration*. https://www.nea.gov.cn/20260529/18c09743776c4dddb55288ceea38b8b1/c.html

Mao, F. F., Wei, Y. F., & Wang, Y. F. (2024). Impact of computing infrastructure on carbon emissions in China. *Scientific Reports*, *14*(1), Article 29814. https://doi.org/10.1038/s41598-024-81677-4

Meige, A., Harmache, C., Eagar, R., Agrawal, S., Muller-Elschner, T., Siraudin, A., Carlot, F., Thurmann-Moe, L., Marjanovic, M., & Riegel, L. (2026). *AI's hidden dependencies*. Arthur D. Little. https://www.adlittle.com/en/ai-hidden-dependencies

National Development and Reform Commission, National Data Administration, Office of the Central Cyberspace Affairs Commission, Ministry of Industry and Information Technology, & National Energy Administration. (2023). *Guanyu shenru shishi Dong Shu Xi Suan gongcheng jiakuai goujian quanguo yitihua suanliwang de shishi yijian* (Fagai Shuju [2023] No. 1779). https://www.gov.cn/zhengce/zhengceku/202401/content_6924596.htm

National Development and Reform Commission, Office of the Central Cyberspace Affairs Commission, Ministry of Industry and Information Technology, & National Energy Administration. (2021a). *Quanguo yitihua dashuju zhongxin xietong chuangxin tixi suanli shuniu shishi fang'an* (Fagai Gaoke [2021] No. 709). https://www.gov.cn/zhengce/zhengceku/2021-05/26/content_5612405.htm

National Development and Reform Commission, Office of the Central Cyberspace Affairs Commission, Ministry of Industry and Information Technology, & National Energy Administration. (2021b). *Guanyu tongyi Ningxia Huizu Zizhiqu qidong jianshe quanguo yitihua suanli wangluo guojia shuniu jiedian de fuhan* (Fagai Gaoke [2021] No. 1841). https://www.ndrc.gov.cn/xxgk/zcfb/tz/202112/t20211229_1310526.html?state=123

National Development and Reform Commission, Office of the Central Cyberspace Affairs Commission, Ministry of Industry and Information Technology, & National Energy Administration. (2022a). *Guanyu tongyi Jingjinji diqu qidong jianshe quanguo yitihua suanli wangluo guojia shuniu jiedian de fuhan* (Fagai Gaoke [2022] No. 212). https://www.ndrc.gov.cn/xxgk/zcfb/tz/202202/t20220216_1315621.html

National Development and Reform Commission, Office of the Central Cyberspace Affairs Commission, Ministry of Industry and Information Technology, & National Energy Administration. (2022b). *Guanyu tongyi Chengyu diqu qidong jianshe quanguo yitihua suanli wangluo guojia shuniu jiedian de fuhan* (Fagai Gaoke [2022] No. 88). https://zfxxgk.ndrc.gov.cn/web/iteminfo.jsp?id=18689

National Development and Reform Commission, Office of the Central Cyberspace Affairs Commission, Ministry of Industry and Information Technology, & National Energy Administration. (2022c). *Guanyu tongyi Changsanjiao diqu qidong jianshe quanguo yitihua suanli wangluo guojia shuniu jiedian de fuhan* (Fagai Gaoke [2022] No. 211). https://www.ndrc.gov.cn/xxgk/zcfb/tz/202202/t20220216_1315623.html?state=123

National Development and Reform Commission, Office of the Central Cyberspace Affairs Commission, Ministry of Industry and Information Technology, & National Energy Administration. (2020). *Guanyu jiakuai goujian quanguo yitihua dashuju zhongxin xietong chuangxin tixi de zhidao yijian* (Fagai Gaoke [2022] No. 1922). https://www.ndrc.gov.cn/xxgk/zcfb/tz/202012/t20201228_1260496.html

Neimenggu shuniu dazao lvse kesuyuan Helinge'er jiqun tuijin suandian xietong fazhan. (2024, September 24). *National Data Administration*. https://www.nda.gov.cn/sjj/zhuanti/ztdsjblh/ztxwfb/0925/20240925131014579442012_pc.html

Nguyen, T., & Green, B. (2025). *What happens when data centers come to town?* https://stpp.fordschool.umich.edu/sites/stpp/files/2025-07/stpp-data-centers-2025.pdf

OECD. (2024, January 29). *Mainstreaming biodiversity into renewable power infrastructure*. https://doi.org/10.1787/357ac474-en

Olsson, P., Folke, C., & Hughes, T. P. (2008). Navigating the transition to ecosystem-based management of the Great Barrier Reef, Australia. *Proceedings of the National Academy of Sciences of the United States of America*, *105*(28), 9489–9494. https://doi.org/10.1073/pnas.0706905105

Quanguo shouge shujuzhongxin lvdianzhilian yuanwanghechu yitihua xiangmu shunli bingwang touyun. (2025, July 24). *State-Owned Assets Supervision and Administration Commission of the State Council*. http://www.sasac.gov.cn/n2588025/n2588129/c34048855/content.html

State Council of the People's Republic of China. (2024). *Shengtai baohu buchang tiaoli* (Guoling No. 779). https://www.gov.cn/zhengce/zhengceku/202404/content_6944395.htm

Turner, M. (2026). *Loudoun County, Virginia: Data center capital of the world*. https://www.loudoun.gov/ArchiveCenter/ViewFile/Item/13979

Wang, L., Chen, D. L., Wang, J. C., & Fu, M. (2025). Zhongguo shuju zhongxin de kongjian buju yanhua jiyingxiang yinsu. *Human Geography*, *40*(2), 116–127. https://doi.org/10.13959/j.issn.1003-2398.2025.02.012

Wang, Y. K. (2024). Shuju Yaosu × yu Dong Shu Xi Suan: Quanguo Yitihua Suanli Wang Jianshe de Guanjian. *People's Tribune*, *32*(8), 52–56.

World Resources Institute. (2016). *MRV 101: Understanding measurement, reporting, and verification of climate change mitigation*. https://www.wri.org/research/mrv-101-understanding-measurement-reporting-and-verification-climate-change-mitigation

Yang, X. Y., & Liu, Q. (2026). The value, current challenges, and paths for promoting digital economic development in western China: Based on the perspective of regional coordinated development. *Journal of Shanghai University of Finance and Economics*, *28*(1), 3–18. https://doi.org/10.16538/j.cnki.jsufe.2026.01.001

Zhang, N., Duan, H. B., Guan, Y. R., Mao, R. C., Song, G. H., Yang, J. K., & Shan, Y. L. (2025). The "eastern data and western computing" initiative in China contributes to its net-zero target. *Engineering*, *52*, 256–261. https://doi.org/10.1016/j.eng.2024.08.010

Zhao, X. C., Li, F. S., Yuan, Y., Ari, G., Yan, Y. Z., Zhang, Q., Olhnuud, A., & Liu, P. T. (2025). Wind farms reduce grassland plant community diversity and lead to plant community convergence. *BMC Ecology and Evolution*, *25*, Article 10. https://doi.org/10.1186/s12862-025-02350-6

Zhou, K. L., Yang, Z., Lu, X., & Hu, R. (2026). Carbon emissions flow and inequality embodied in cross-regional computility transfer in China. *Humanities and Social Sciences Communications*, *13*, Article 123. https://doi.org/10.1057/s41599-025-06431-1

About the Authors



Haifeng Deng is a professor and PhD supervisor at Tsinghua University. He directs the Center for Environmental, Natural Resources and Energy Law at the School of Law and serves as a council member of the China Law Society. He is also a member of the International Law Association Committee on Green Trade and Sustainable Investment.



Yuchen He is a PhD student in environmental and energy law at Tsinghua University. Her research interests include environmental and energy justice, artificial intelligence governance, and protected area governance.