国家信息中心
State Information Center

Low-Carbon and Green Transformation of China's Computing Power Industry

IEF
Nov. 21st, 2024

CONTENTS

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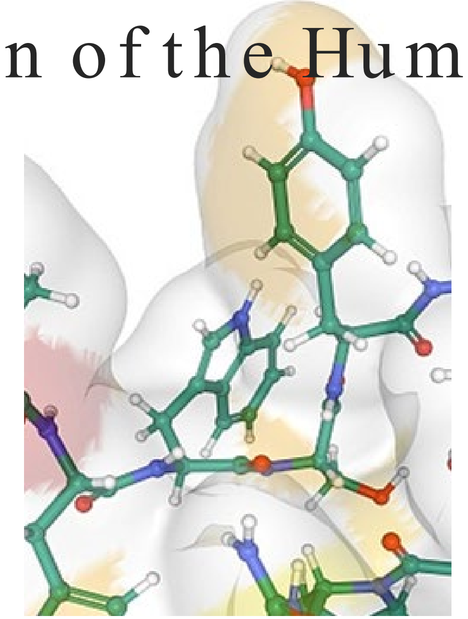
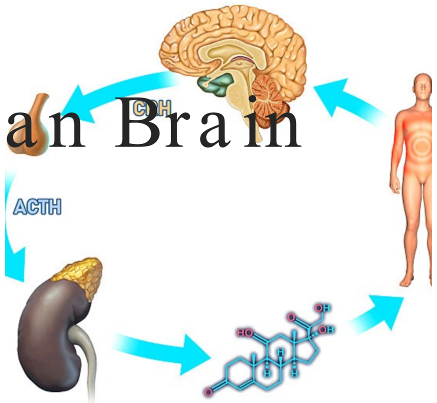
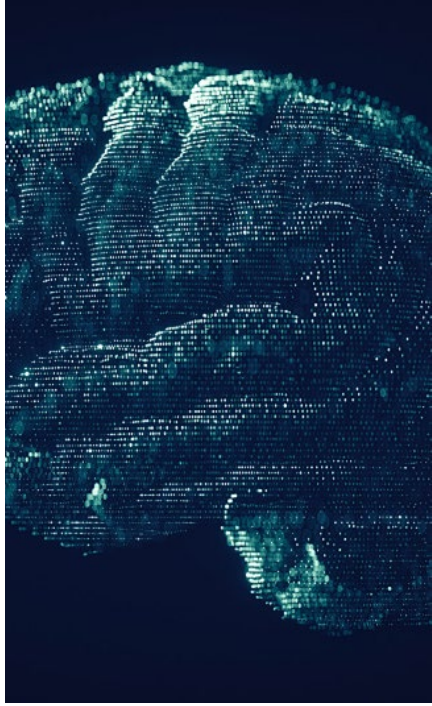
Evolution of Intelligence and Energy Requirment

The Emergence and Evolution of the Human Brain

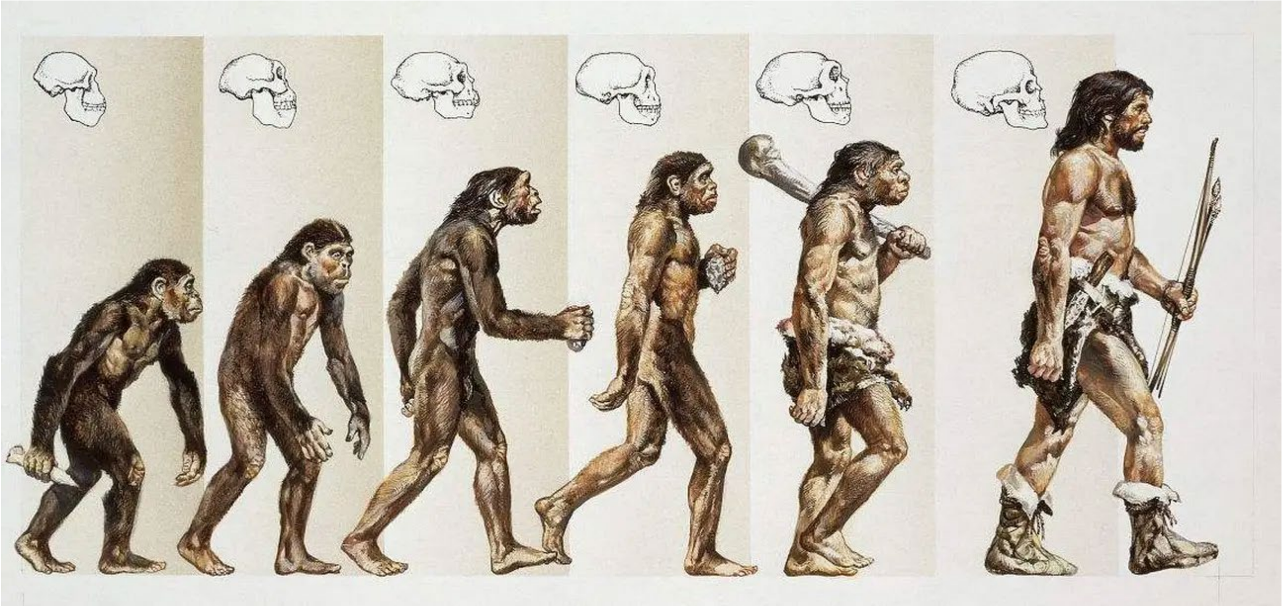




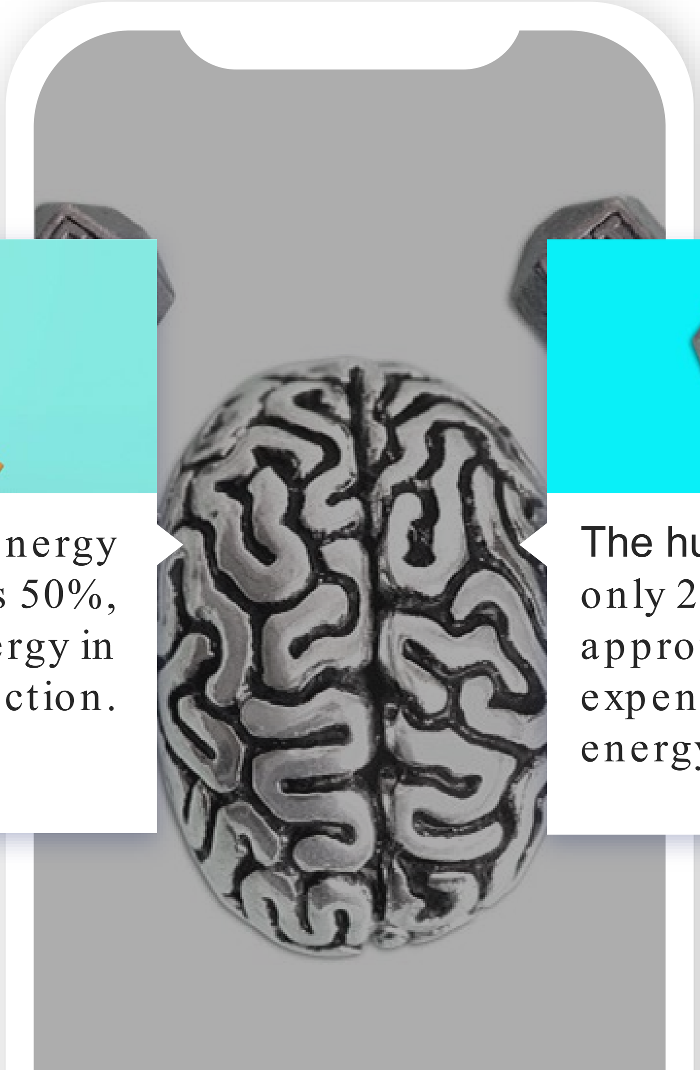


> The development of the human brain, from early hominins to modern Homo sapiens, has been a pivotal factor in the evolution of human intelligence and cognitive abilities.

This evolutionary journey has seen a significant increase in brain capacity, from around 350-400 ml in early hominins to 1,200-1,500 ml in early Homo sapiens, facilitating complex neural activity and high-level cognitive functions.



Energy Demands of the Human Brain



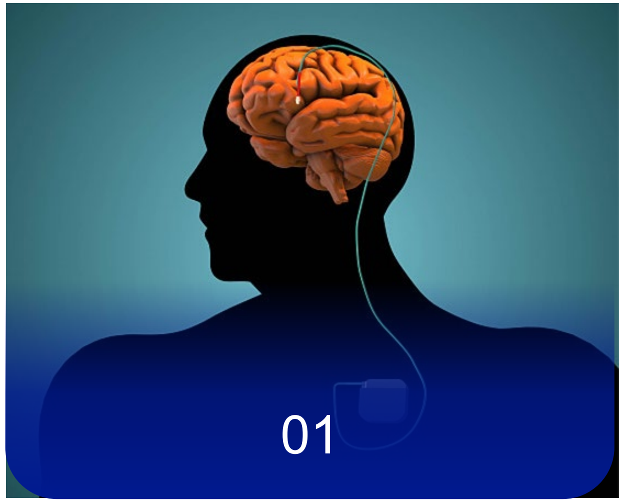
01

The human brain, despite accounting for only 2% of body weight, consumes approximately 20% of the total energy expenditure in adults, highlighting its high energy requirements.

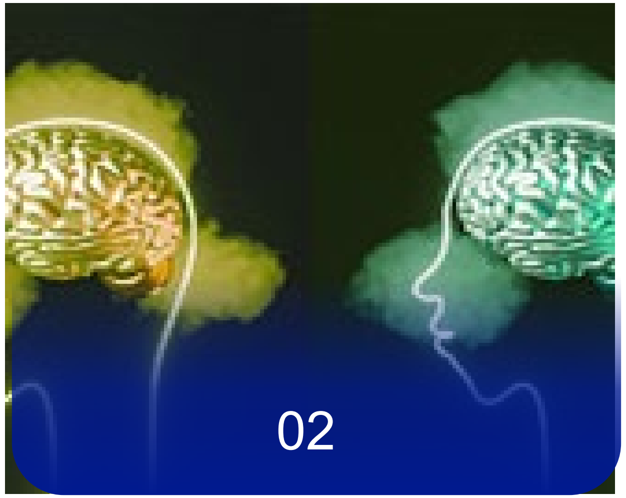
02

In children and adolescents, this energy consumption can be as high as 50%, emphasizing the critical role of energy in brain development and function.

Dietary Adaptations and Health Implications



The brain's reliance on glucose for energy has led to a shift in dietary habits, with carbohydrates becoming a staple in the human diet.

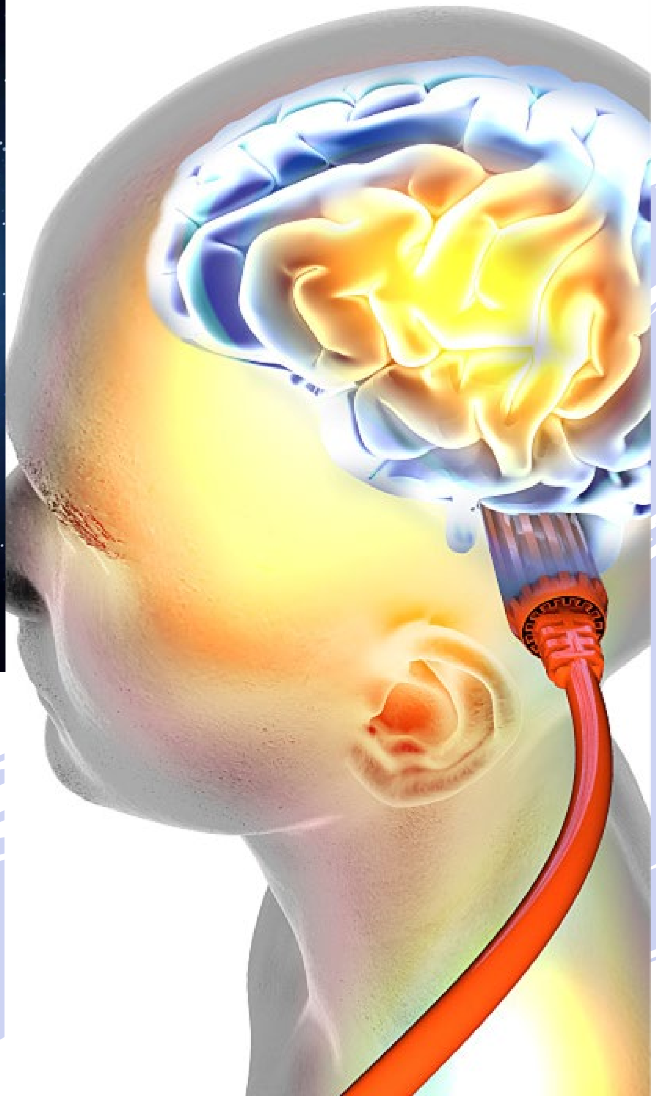


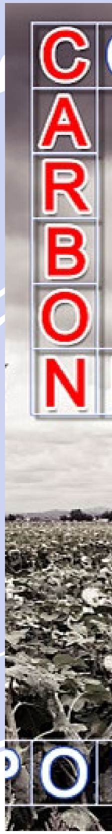
This dietary shift, coupled with the brain's high energy demands, has contributed to an increased prevalence of insulin resistance and diabetes, necessitating compensations in human health to meet the evolutionary demands of an energy - intensive brain.

Implications for Energy Consumption and Sustainability

Understanding the energy demands of the human brain provides insights into the energy-intensive nature of computational systems and the challenges associated with their sustainable operation.

This understanding can inform strategies for optimizing energy consumption in the computing power industry, promoting a low-carbon and green transformation.





02

AI and its Challenge to Carbon Reduction

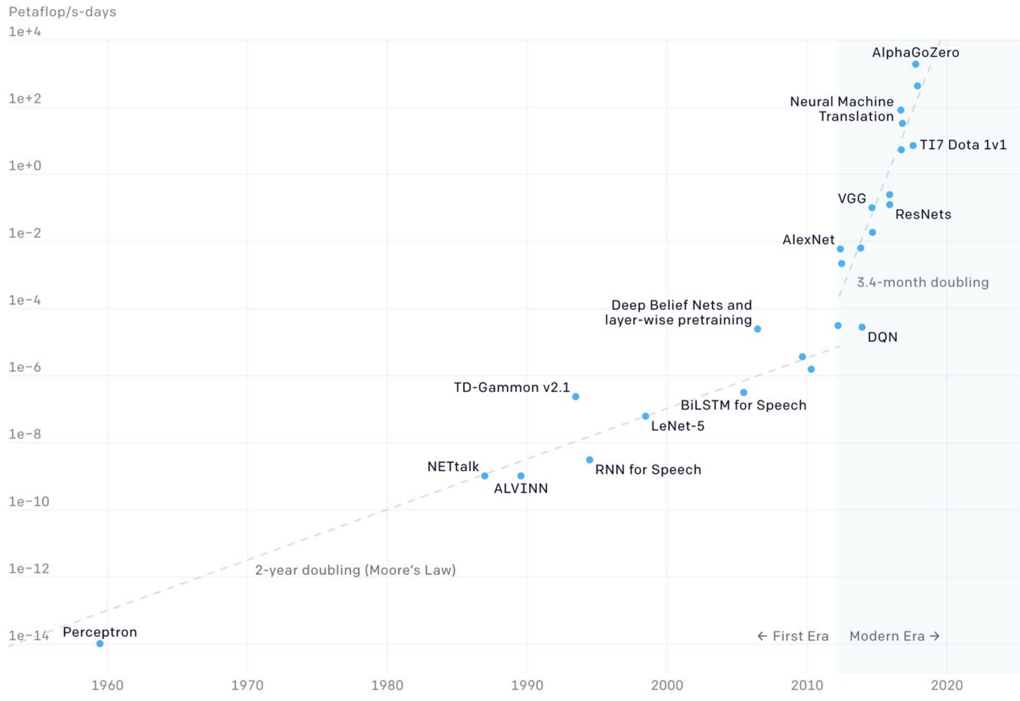
Escalating Energy Demands of AI

01

Since 2012, the computational power required for AI has grow 300,00 -fold, doubling roughly every 100 days since 2012, surpassing Moore's Law greatly. Within the first 18 months after ChatGPT' s release, demand for computational power increased 35-fold.

02

This rapid growth in energy demand poses challenges for the computing power industry, with predictions indicating potential bottlenecks due to electricity shortages in the future.



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The Electricity Challenge Brought by the Surge in Computing Power: Expert Opinions

Jensen Huang --NVIDIA

We need 14 different planets, 3 galaxies, 4 more suns to power future AI GPU tech

Elon Musk --Tesla

AI will run out of electricity and transformers in 2025

Sam Altman --OpenAI

An energy breakthrough is necessary for future artificial intelligence, which will consume vastly more power than people have expected

Energy Consumption and Environmental Impact

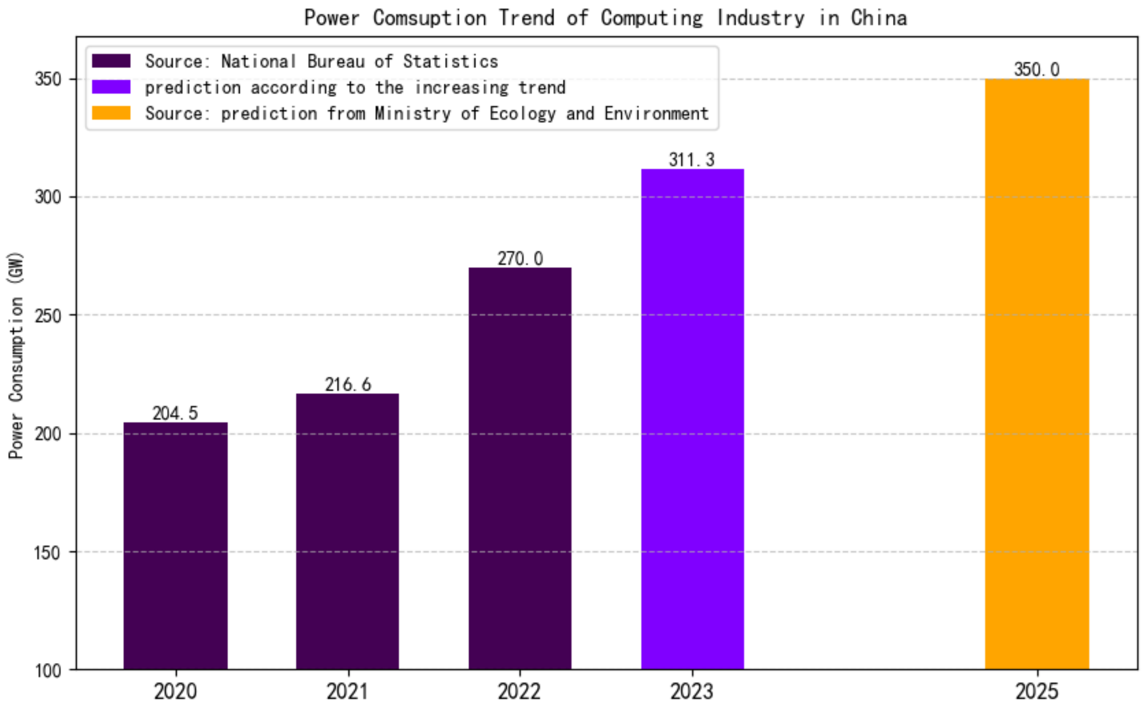
The energy consumption of data centers is a significant concern, with just 70 data centers in Ireland accounting for 14% of the country's total electricity consumption.

By 2030, AI is projected to consume 30- 50% of global electricity, highlighting the urgent need for sustainable energy solutions to mitigate the environmental impact of the computing power industry.

China's Challenges and Initiatives

China, like other countries, faces similar challenges in managing the energy consumption of its data centers, with projections indicating a significant increase in energy consumption by 2025.

China's data centers are expected to consume 311.3 billion kWh in 2023, about 1.5 times the amount in 2020. And total energy consumption by China's data centers is projected to reach 350 billion kWh by 2025, accounting for roughly 4% of the national electricity consumption.



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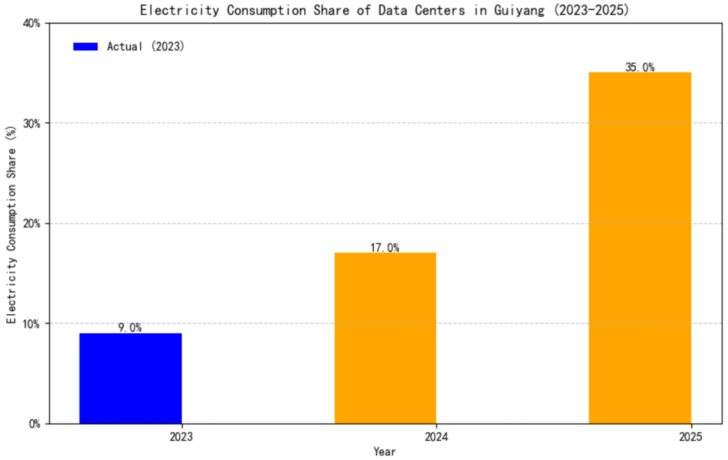


In Guiyang, a hub for China's computing industry, data center energy consumption reached 9% of total city consumption in 2023, projected to reach 16-18% by 2024 and up to 35% by 2025.

Dependence on Electricity and Stability Requirements

Silicon-based intelligence systems, rely solely on electricity for their operation, emphasizing the importance of stable and reliable power supply.

As intermittent renewable sources such as wind, solar, and tidal power cannot directly power computational systems, this dependence on stable power inputs presents challenges to carbon reduction initiatives.

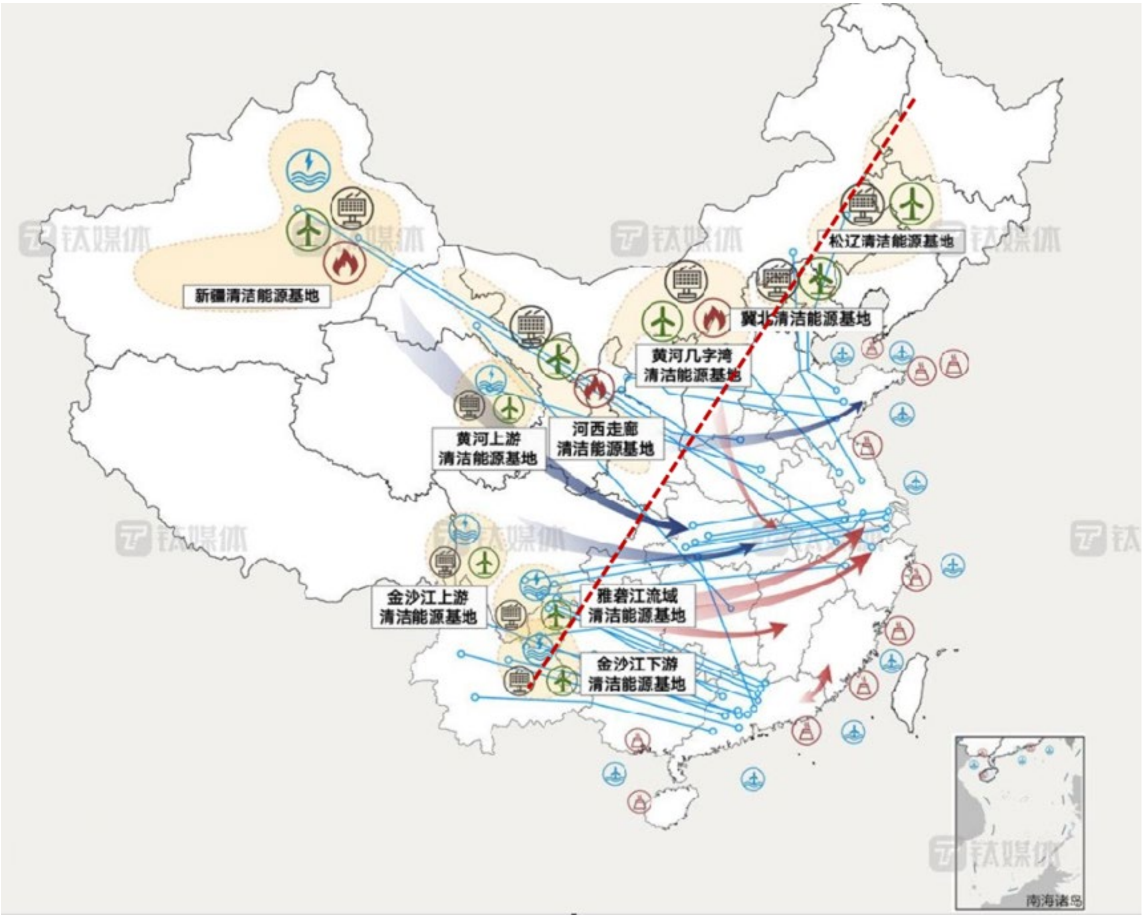
03

Eastern Data Western Computing

China's Spatial Economy and Energy Resources

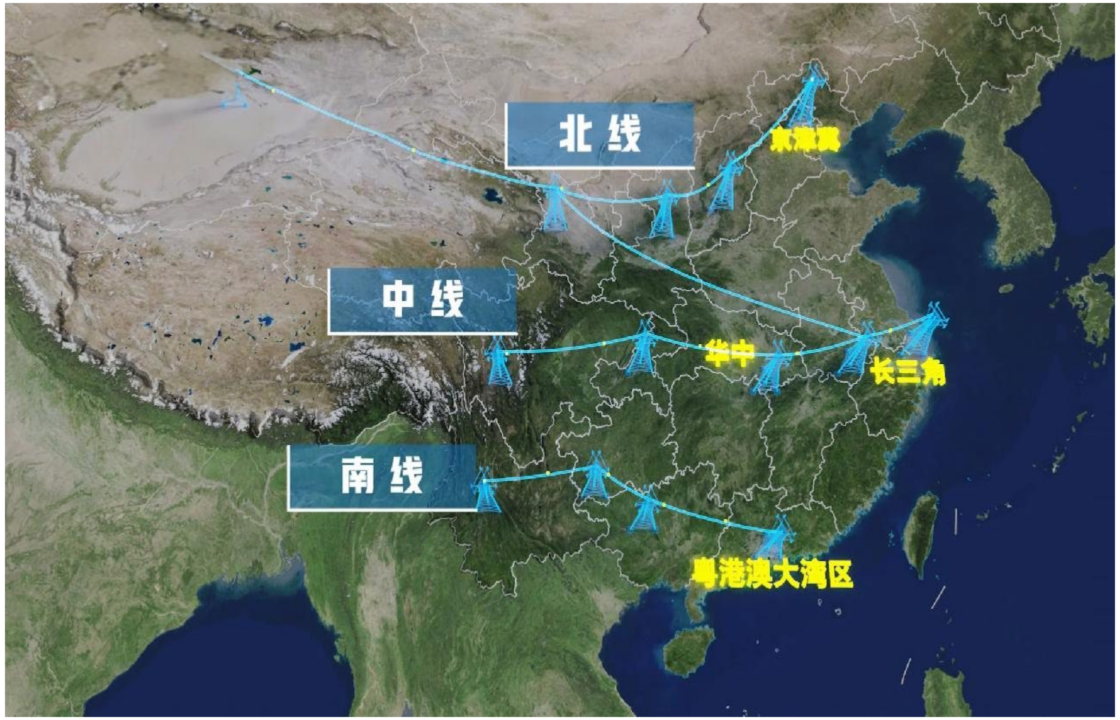
China's spatial economy is characterized by a concentration of population, industry, and cities along the eastern coast, while the western regions possess abundant energy resources but are economically underdeveloped.

The Huhuanyong Line, dividing China into eastern and western regions, highlights the stark population and economic disparities, with the east holding 96% of the population and the west only 4%.



China's Spatial Economy and Energy Resources

In order to address this unbalanced phenomenon since 2000, China has implemented the " West-to-East Power Transmission" initiative, leveraging ultra-high-voltage transmission technology to deliver abundant western power resources to the eastern economic hubs via three main north, central, and south transmission corridors.



Although this mega project has played important functions such as providing stability, inclusiveness and coordination, due to the volatility of green energies like photovoltaic and wind power, it is difficult to supply the eastern market through this super power grid.

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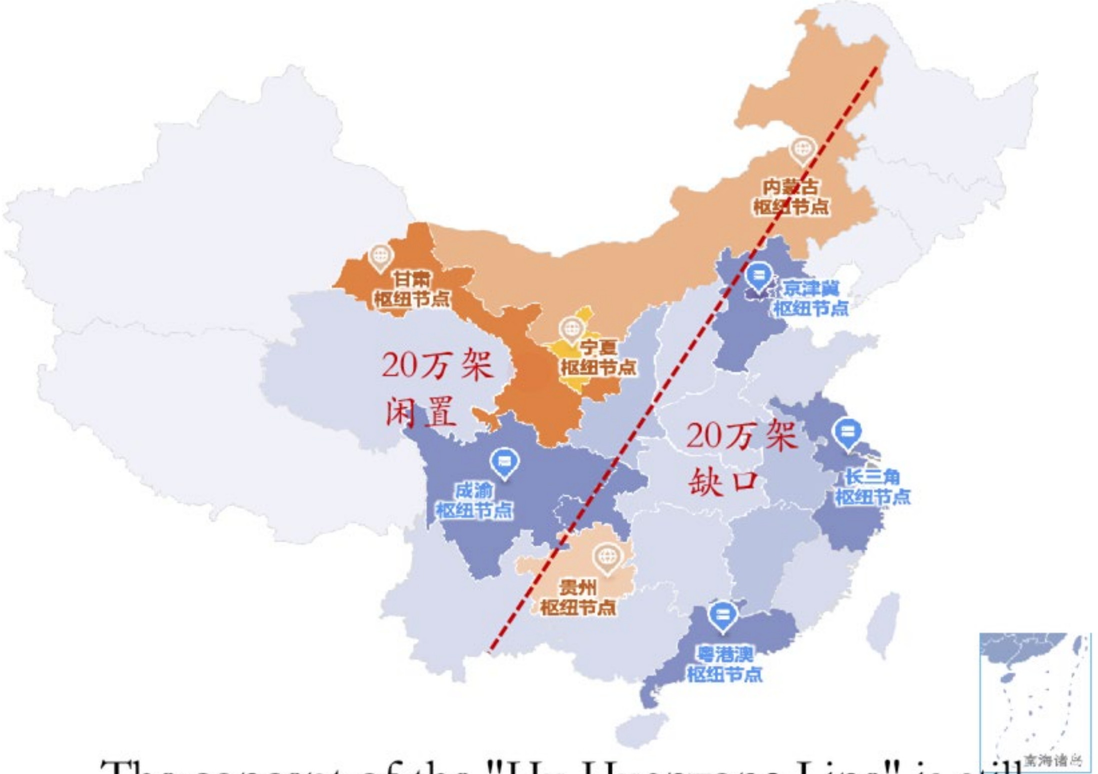
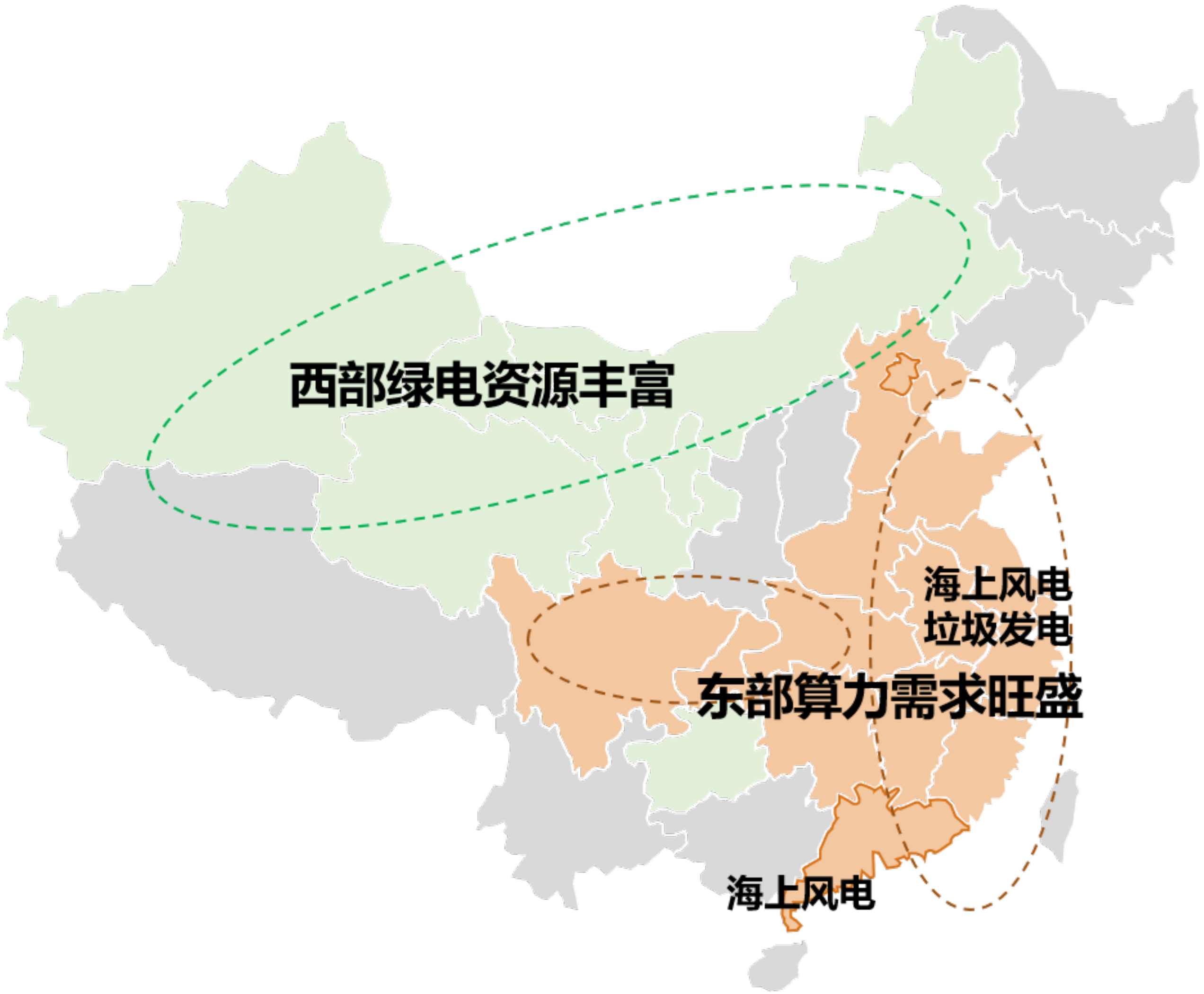


The concept of the "Hu Huanyong Line" is still applicable in the field of computing power.

China's Challenges and Solutions

Inspired by the model of "West -to-East Power Transmission", China has introduced initiatives such as the "Eastern Data, Western Computing" strategy, which has evolved into the "National Integrated Computing Power Network（NICPN）".

This mega project aims to leverage the surplus energy in western regions by converting it into data processing capacity, to optimize energy utilization and promote a low- carbon transformation.



From "Eastern Data, Western Computing" Strategy to NICPN

- The giant project involves the integration of computing power and intelligent scheduling, creating high-throughput, low-latency computing clusters to support the growing demands of the computing power industry.

- This network involves the construction of eight national computing hubs and ten national data center clusters, aiming to create a cohesive and efficient computing infrastructure across the country.

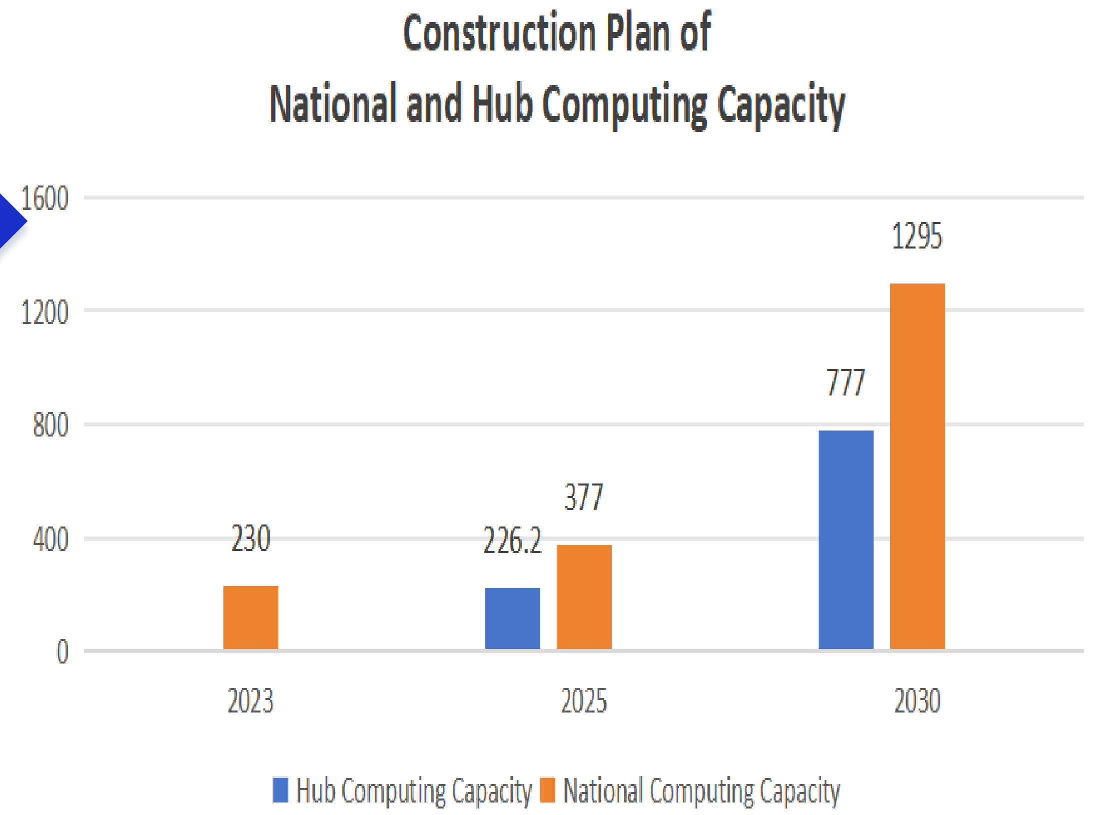
Progress and Interim results

- As of June 2024, direct investment in the eight major national hubs exceeded 43.5 billion yuan, attracting over 200 billion yuan in additional investment.
- Rack capacity surpassed 1.95 million, with an overall utilization rate of around 63%, a 4% increase from 2022, establishing a preliminary framework for the eight hubs.
- Network latency between eastern and western hubs now generally meets the 20-millisecond target.
- Power usage effectiveness (PUE) of newly built data centers has dropped to a low of 1.04.

Expectations for Construction Progress

According to the construction plan of NICPN, it is expected that by 2030, the scale of computing power across the country will be nearly six times that at the end of 2023, with 60% of it being the computing power deployed at hub nodes.

Moreover, 80% of it will be powered by green electricity, thus making full use of the abundant photovoltaic and wind power in the western regions.



04

Future Work

Enhancing Green Power Resources to Support Computing Capacity

01

Exploring direct green power supply to data centers, establishing dedicated green power distribution networks around data centers to further reduce energy costs

02

Applying new energy storage technologies to develop large-capacity, long-duration storage, including advanced technologies such as hydrogen storage

03

Promoting the supply-demand alignment of the computing and power networks and facilitating inter-regional coordination and scheduling of green computing resources

05

Cooperative Opportunities

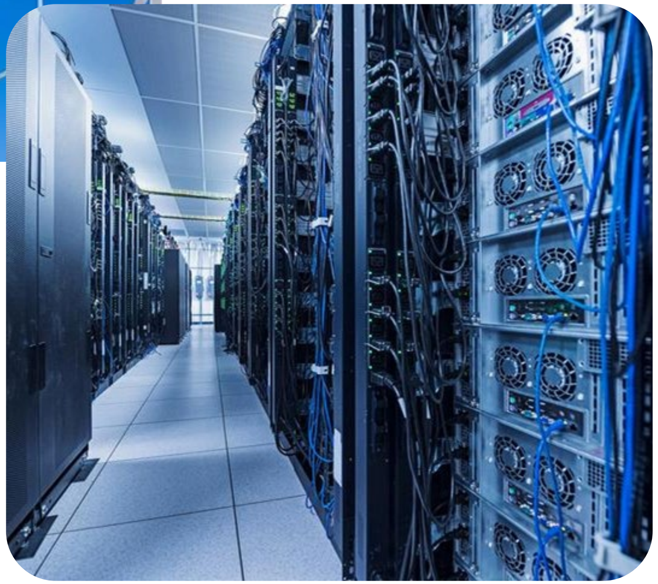
IEF as a Dialogue Platform

01

Computing power has already become an essential and rapidly growing energy demand market.

02

IEF could play a crucial role in meeting computing market demands and fostering computing power supply infrastructure.



Creating New Growth Points for Energy Exporting Countries

Traditional energy-exporting countries, particularly in the Arab region, possess substantial solar and wind resources, offering significant potential to become key suppliers of green energy.

By fully mobilizing these resources and potentially building nuclear plants, these regions can generate low-cost green power, enabling the establishment of computing clusters that serve both local and export demand, providing a new economic growth path in the post-oil era.

Suggestions for Future Cooperation with IEF

01

Engaging in dialogues regarding the impact of computing power supply and demand on energy markets, particularly in terms of computing and power coordination.

03

Establishing a long - term platform to share the latest progress in the green and low - carbon transition of the computing industry with IEF member countries, promoting knowledge exchange and collaboration.

02

Collaborating on tracking, aggregating, and analyzing data on China's and the global computing power markets to inform decision - making and policy development.

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