

Powering the Cloud: How China's Internet Industry Can Shift to Renewable Energy

*The following is a summary of key findings from the report
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Renewable Energy," published by Greenpeace East Asia and the
North China Electric Power University. For more details, please
refer to the full report [in Chinese].*

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Section 1

Rapid Growth in Energy Consumption

China's hyperscale data center industry is the second largest in the world, comprising 8% of the global market.¹ Researchers estimate that in 2018 China was home to 1.2 million server racks from large and ultra-large scale data centers and 1.5 million server racks from small and mid-scale data centers.

China's data center industry consumed 161 TWh of electricity in 2018, or 2.35% of the country's total electricity consumption. Researchers found that electricity consumption from the industry is on track to increase by 66% in the next five years, reaching

267 TWh by 2023, more than Australia's total 2018 electricity consumption.² In a typical data center in China, 80% of electricity is consumed by servers and cooling equipment.³

From 2015 to 2017, the industry grew at a rate of over 10% per year by floor area. The market for internet data centers in China, including colocation, content delivery network (CDN) services, and public cloud services, has expanded at a rate of approximately 30% per year and is on track to surpass RMB 270 billion by 2021.⁴

Data Centers in China by Floor Area (2015-2017)⁵

YEAR	2015	2016	2017
Floor Area (10,000 m ²)	1,502.3	1,660.9	1,840.7

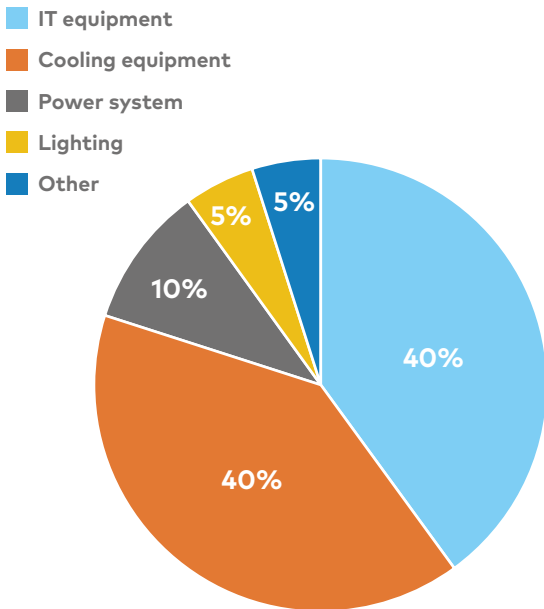
China Internet Data Center Market Growth Forecast (2018-2021)⁶

YEAR	2018	2019	2020	2021
Market Size (billion RMB)	122.8	158.6	207.9	276.0

Electricity Consumption of China's Data Center Industry (2018-2023)

YEAR	2018	2019	2020	2021	2022	2023
Total Electricity Consumption (TWh)	160.89	178.02	196.96	217.93	241.13	266.79

Breakdown of Data Center Electricity Consumption (2016)⁷



While data center companies in China have implemented reforms to improve energy efficiency, (measured by the commonly used indicator PUE, or power usage effectiveness), more action is needed to curtail growing carbon emissions and air pollutants that result from heavy reliance on coal power. This problem can be addressed by actively procuring wind and solar energy.

China's data centers are most heavily concentrated in eastern provinces, in and near the country's largest cities. More than 40% of China's large-scale data center market is located in Beijing, Shanghai, and Guangdong, followed by Inner Mongolia, Zhejiang, Jiangsu and Guizhou.⁸

Over the next five years, the most dramatic growth in data center electricity consumption is projected to occur in Guangdong, Jiangsu, Zhejiang, Inner Mongolia, and Hebei – comprising 48.8% of new growth. By contrast, Beijing and Shanghai will likely see limited growth due to tightening of PUE regulations.

China Data Center Industry Electricity Consumption by Province (2018-2023)				
Province	2018 Data Center Electricity Consumption (100 GWh)	2023 Data Center Electricity Consumption Forecast (100 GWh)	Projected Growth in Data Center Electricity Consumption 2018-2023 (100 GWh)	Projected Growth in Data Center Electricity Consumption 2018-2023 (percent)
Guangdong	268.17	407.07	138.90	51.80%
Shanghai	144.36	156.00	11.63	8.06%
Beijing	112.69	123.82	11.13	9.87%
Inner Mongolia	79.06	179.66	100.60	127.25%
Zhejiang	109.95	176.56	66.61	60.58%
Jiangsu	130.14	268.67	138.53	106.45%
Guizhou	50.47	75.09	24.62	48.79%
Hebei	51.53	123.93	72.40	140.51%
Liaoning	49.12	83.61	34.48	70.20%
Sichuan	60.80	97.58	36.79	60.50%
Heilongjiang	34.85	44.36	9.52	27.31%
Shaanxi	40.99	62.21	21.23	51.79%
other	476.78	869.37	392.59	82.34%
Total	1,608.89	2,667.92	1,059.03	65.82%

Section 2

Reliance on Coal

At present, few data centers in China actively procure renewable energy on a large scale. Researchers estimate that 73% of electricity consumed by China's data centers in 2018 was generated from coal and procured from the grid.

Because the data center industry is concentrated in areas where renewable energy comprises a relatively small portion of the electricity mix, as is the case in Beijing, Zhejiang and Jiangsu etc., the industry's rate of renewable energy consumption falls below the national average of 26.5%.⁹

The environmental impact of the data center sector's reliance on coal power is significant. CO2 emissions from the sector amounted to 99 million tonnes in 2018.

The report outlines two scenarios for future emissions growth from China's data center industry. If the sector's renewable energy intake remains steady at 23%, CO2 emissions are projected to reach 163 million tonnes by 2023. However, if renewable energy intake increases to 30%, 16 million tonnes of carbon emissions can be avoided.

Researchers studied 44 data centers across 12 Chinese provinces and found that nearly 90% of these data centers sourced power directly from the grid and had not yet taken active measures to procure renewable energy.

Data Center Electricity Mix in China (2018)		
Source	Electricity (TWh)	Percentage
Renewables	36.92	23%
Nuclear	6.79	4% ¹⁰
Coal	117.18	73%
Total	160.89	100%

Air Pollutants from Electricity Consumed by Data Centers in China (2018) ¹¹ (tonnes)			
CO ₂	SO ₂	NO _x	Dust
98,550,000	23,436	22,264	4,687

CO2 Emission Scenarios for China's Data Center Sector in 2023 (million tonnes)		
Scenario 1: Data Center Sector Electricity Mix Remains Unchanged, at 23% RE	Scenario 2: Data Center Sector Renewable Energy Intake Increases to 30%	Carbon Emissions Avoided Under Scenario 2
163.42	147.59	15.83

Section 3

Opportunities for Renewable Energy-Powered Data Centers

China is home to more renewable energy capacity than any other country in the world. By the end of 2018, solar installation capacity exceeded 175 GW and wind had surpassed 185 GW, more than Europe's entire solar and wind capacity.¹² Since 2015, power market reforms have created unprecedented opportunities for companies to procure renewable energy via a diverse set of mechanisms.

At present, data centers in China can procure renewable energy via the following three mechanisms:

1. Build or invest in renewable energy projects.

a. Companies can build on-site distributed solar and wind projects near data centers. Renewable energy from these projects can directly power data centers.

b. Companies can build or invest in off-site, utility-scale renewable projects, which indirectly offset electricity that data centers purchase from the local grid.

2. Direct power purchase from renewable energy generators. As power markets open up, companies can directly purchase renewable energy from generators in some provincial markets.

3. Purchase green power certificates. In July 2017, China launched a pilot program that permits voluntary trade of green power certificates from solar and wind power. Each certificate represents 1 MWh of electricity. Buying green power certificates allows companies to claim environmental benefits associated with renewable energy generation, even if electricity from a renewable power plant does not feed directly into a data center facility.

As China's power market reforms deepen, a number of pilot procurement markets have emerged, including distributed generation markets, interprovincial and spot markets for green energy, etc. These will likely be scaled up within the next few years, which will offer more diversified and cost-effective procurement options for data center companies.

In addition to cutting carbon emissions and air pollution, an increase in renewable energy intake has the potential to lower electricity costs for data center companies and strengthen their international brand recognition.

Section 4

Recommendations

Researchers provide the following recommendations:

For policymakers:

- 1) Expand green power direct purchase pilot markets and lower the bar of entry to the green power market. This would enable corporate buyers of different load size and type to participate.
- 2) Enhance the green power certificate market by allowing a wider range of renewable energy projects to obtain green power certificates, particularly grid parity projects.
- 3) Link provincial energy consumption caps with data center construction approval policies in eastern provinces. Prioritize data centers that procure renewable energy in the construction approval process.
- 4) Encourage the construction of new data centers in provinces with surplus renewable energy resources in central and western China.

For data center companies:

- 1) Set company-wide renewable energy targets and link them to internal key performance indicators.
- 2) Build an internal renewable energy team to lead the transition toward renewable energy from within.

Section 5

Methodology

Researchers relied on a combination of desktop and field research to model the electricity consumption and electricity mix of China's data center sector.

The model is based on comprehensive data for Shanghai's data center industry and 44 data centers across 12 provinces. The following factors were taken into consideration:

1. Capacity of server racks
2. PUE (power usage effectiveness)
3. Power design and capacity
4. Cooling design
5. Data center capacity
6. Geographic distribution of data centers
7. Annual GDP of each province
8. Projected power demand growth for each province
9. Provincial data center regulation and incentive policies
10. Provincial renewable energy and power market policies
11. Other relevant factors

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