



Multi-objective dispatching for the efficient utilization of water resources in TGR

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CYPC

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Overview

Hydropower Reserves in Upstream of the Yangtze River in China



The Main River Basins in China



The Songhua River: 1,927km

The Yellow River: 5,464km

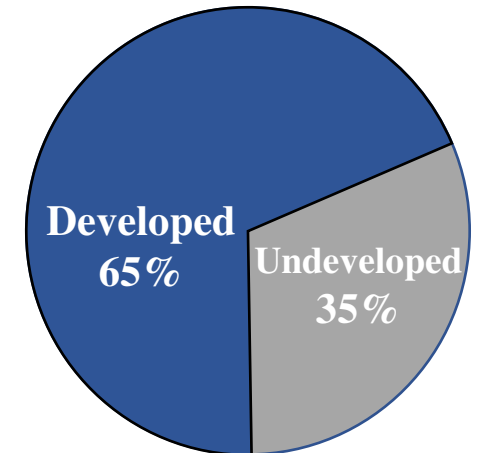
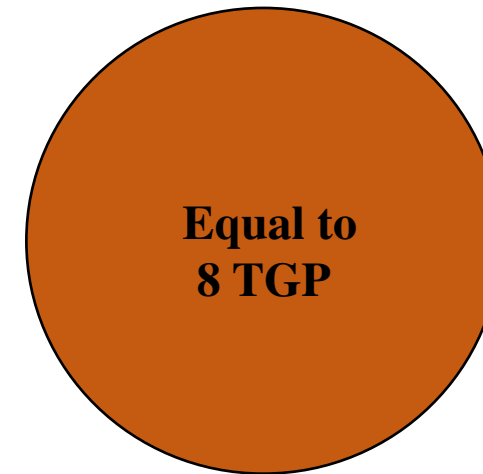
The Yangtze River: 6,300km

Upstream

The Pearl River: 2,216km

Upstream of the Yangtze River

Technically Exploitable Reserves:
178GW
(Top1 in China)



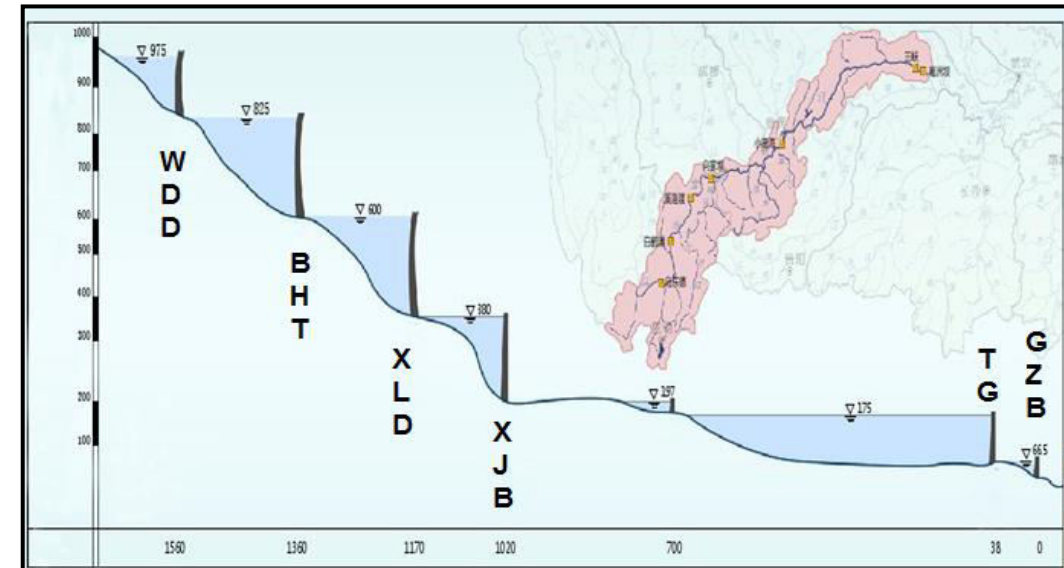
Up to the end of 2021

Up to the end of **2021**, the capacity already installed on the upstream of the Yangtze River **was 115GW**, accounting for **65%** of technically exploitable reserve.



Parameters of Cascade Hydro-Power Stations and Reservoirs

HPS	Hydropower Stations			Reservoirs		
	Units	Installed Capacity (MW)	Average Power Production (MWh)	Normal Water Level (m)	Flood Control Limited Level(m)	Capacity for Flood (Billion m ³)
WDD	12	10,200	39,260	975	952	2.44
BHT	16	16,000	64,100	825	785	7.50
XLD	18	13,860	57,400	600	560	4.65
XJB	8	6,400	30,880	380	370	0.93
TG	34	22,500	88,200	175	145	22.15
GZB	21	2,735	15,700	66	/	/
Total	109	71,695	295,540	/	/	37.67





Cascade Hydropower Stations and Reservoirs of CYPC



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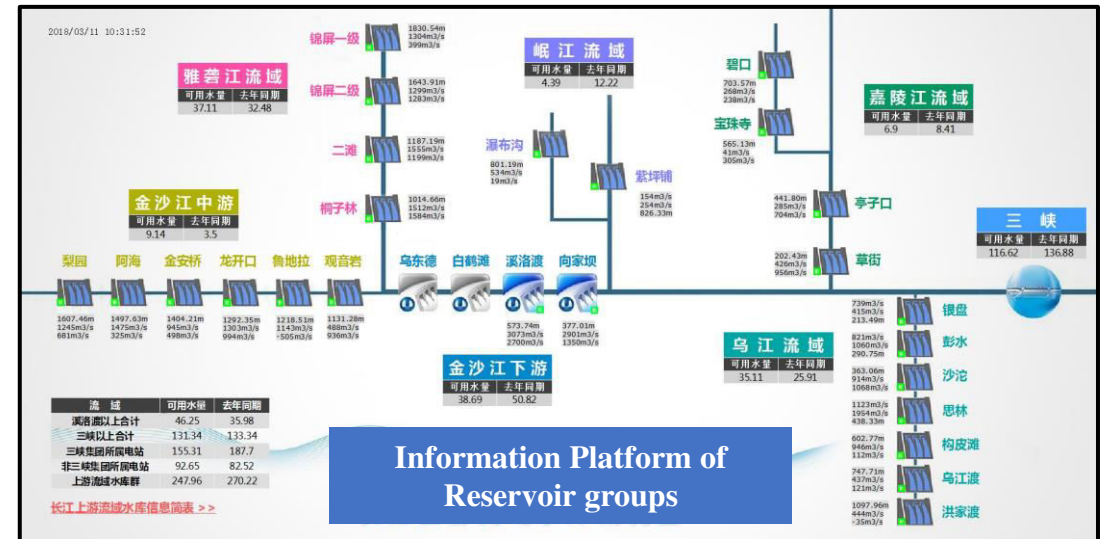
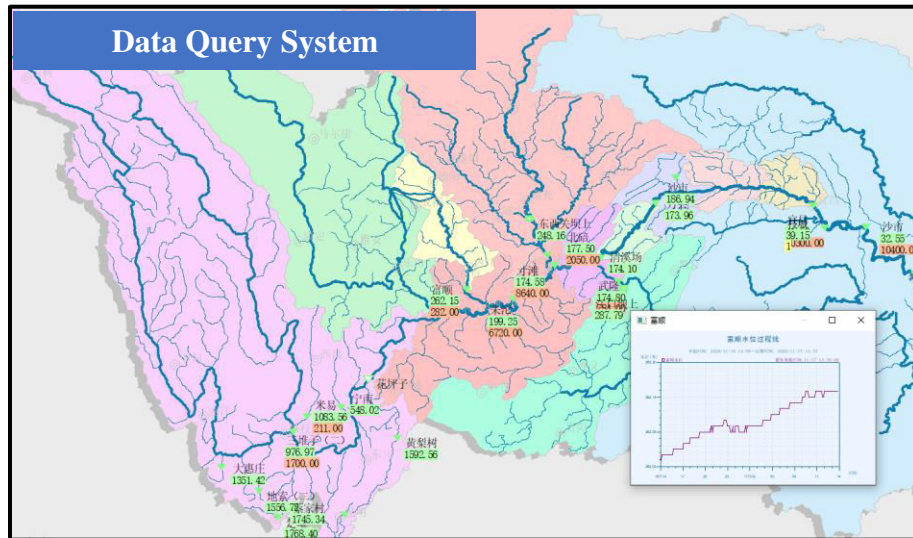
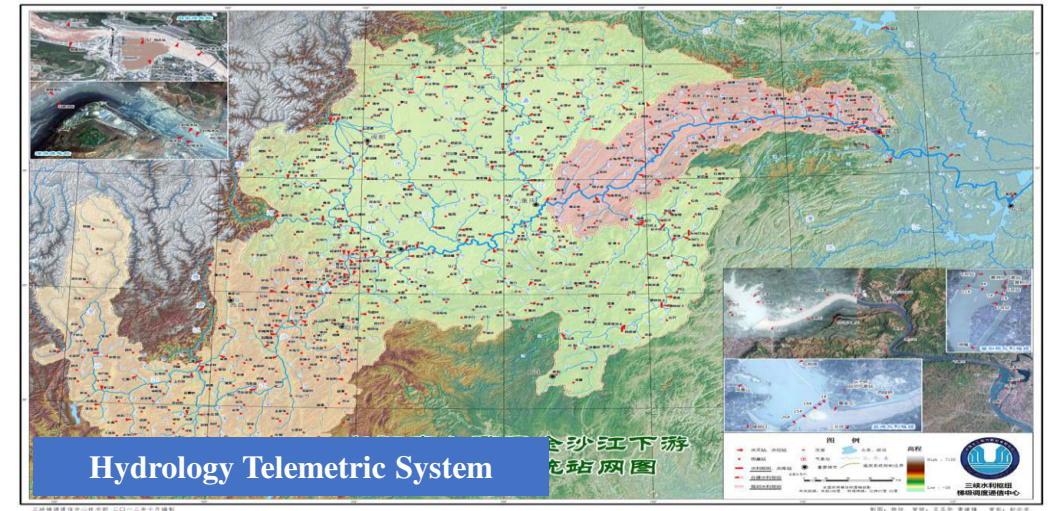
Key Technology



Meteorological and Hydrological Data Monitoring System

Automatic Hydrological Telemetric System

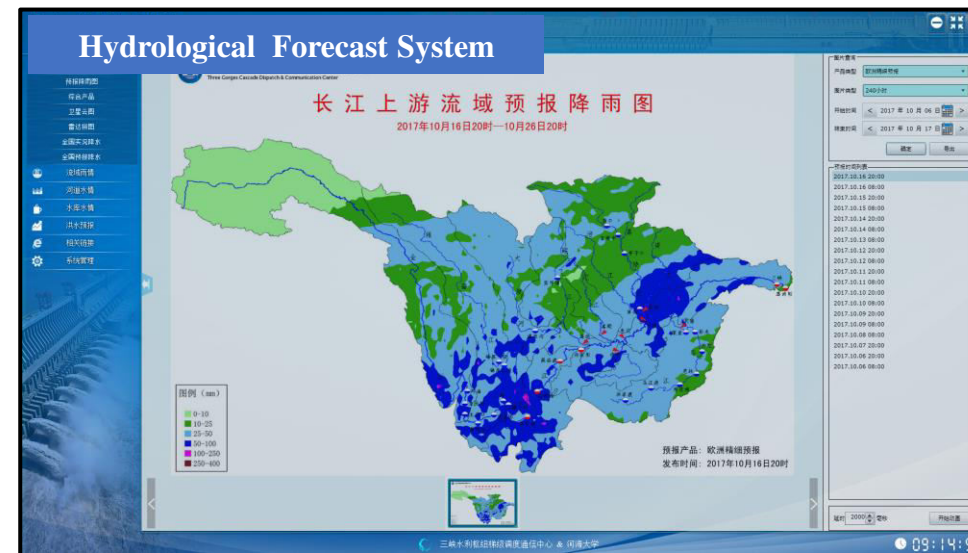
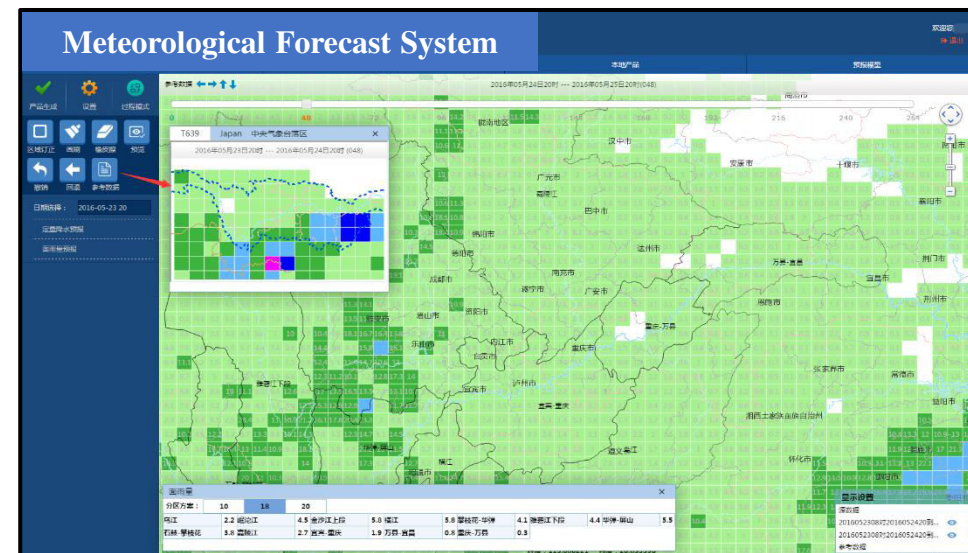
- Establishing 1400 telemetry stations
- Covering nearly 5.8 million km² in the upper Yangzi River Basin
- Only needing 10 minutes to collect the observation data from all stations





Meteorological Forecast System (MFS)

- Including data processing, forecasting result analysis and information services.
- Considering the actual conditions of main hydropower plants
- Strong support for the hydrological forecast and reservoirs dispatching
- Short- and medium- term rainfall forecast and long-term precipitation forecast

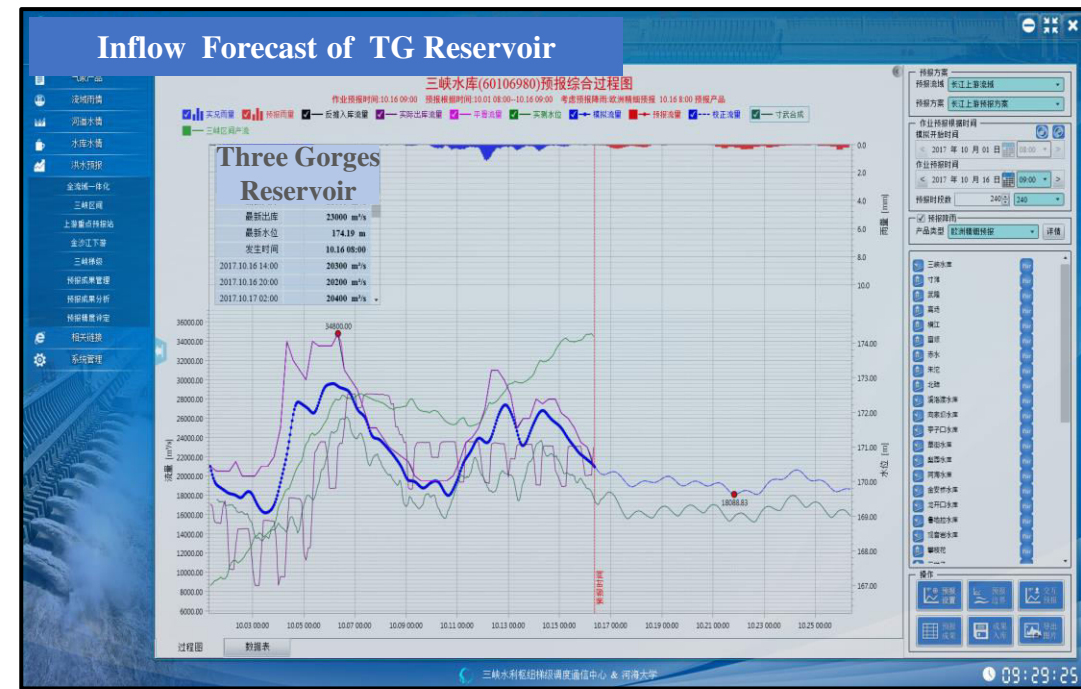
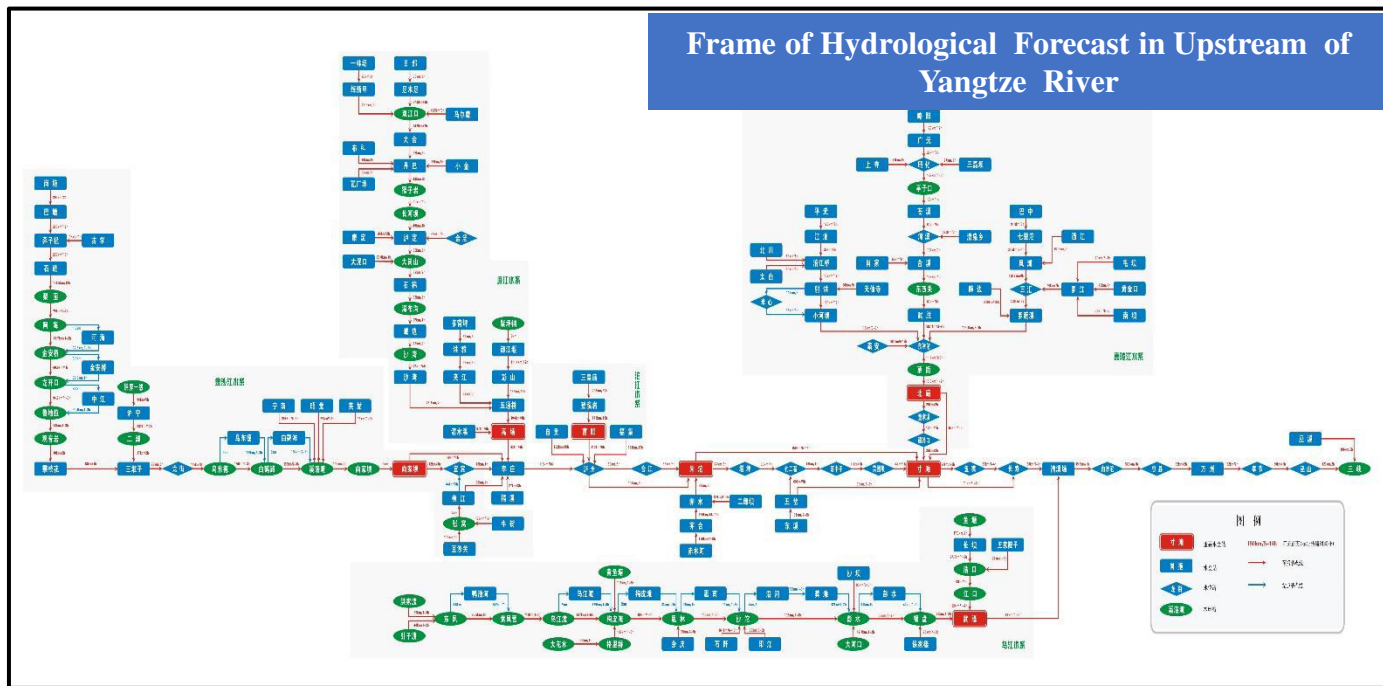




Meteorological and Hydrologic Forecast System

Hydrologic Forecast System(HFS)

- Provide a complete service for river-runoff and reservoir-inflow forecast
- Including 60 river sections and 21 impotent reservoirs in the upper Yangtze River
- Forecast period of HFS ranges from 1-7 days to 1 year
- Correct rate of the short-time-forecast results is more than 98%





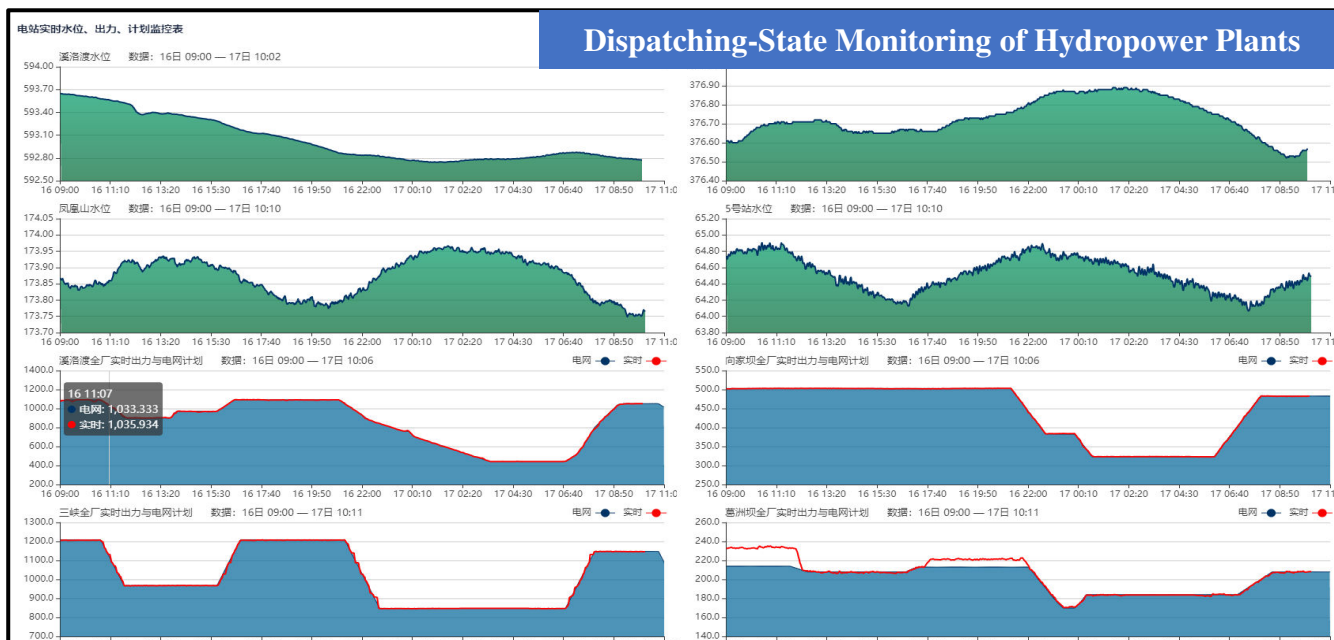
Intelligent Dispatching System (IDS)

- The cloud computing application platform
- Spatial visualization applications
- Big data analyzing and mining

Process Analysis of Historical Operation of Hydropower Plants



Dispatching-State Monitoring of Hydropower Plants



03

Comprehensive Benefits

3.7 Comprehensive Benefits



Flood Control

From 2010 to 2020, **58** flood control dispatches have been carried out, with a total of **188.3** billion m³ of flood storage, effectively ensuring flood control safety in the lower reaches of the Yangtze River.

Statistical Table of Flood Control of Cascade Reservoirs CYPC

Year	Max flood peak(m ³ /s) and Time	Max outflow (m ³ /s)	Max peal clipping(m ³ /s)	Flood control time	Total flood storage capacity (billion m ³)
2010	70,000 20-Jul	40,900	30,000	7	26.6
2011	46,500 21-Sep	29,100	25,500	5	18.8
2012	71,200 24-Jul	45,800	28,200	4	22.8
2013	49,000 21-Jul	35,000	14,000	5	11.8
2014	55,000 20-Sep	45,000	22,900	10	17.5
2015	39,000 1-Jul	31,000	7,400	4	8.85
2016	50,000 1-Jul	31,000	19,000	4	9.78
2017	31,000 27-Aug	19,000	12,000	3	10.4
2018	60,000 14-Jul	40,000	20,000	3	14.9
2019	45,000 8-Aug	32,500	12,500	4	9.80
2020	75,000 20-Aug	48,000	27,000	9	36.9





Navigation

After the Three Gorges project was put into operation, the shipping conditions of the upper reaches of the Yangtze River were greatly improved, and the **10,000** ton fleet could reach Chongqing directly, reduce shipping cost by about **1/3**.

The annual cargo volume of the Three Gorges section increased from **18** million tons before the completion of the project to **150** million tons **in 2019**.



Navigation Benefits From the Three Gorges Project

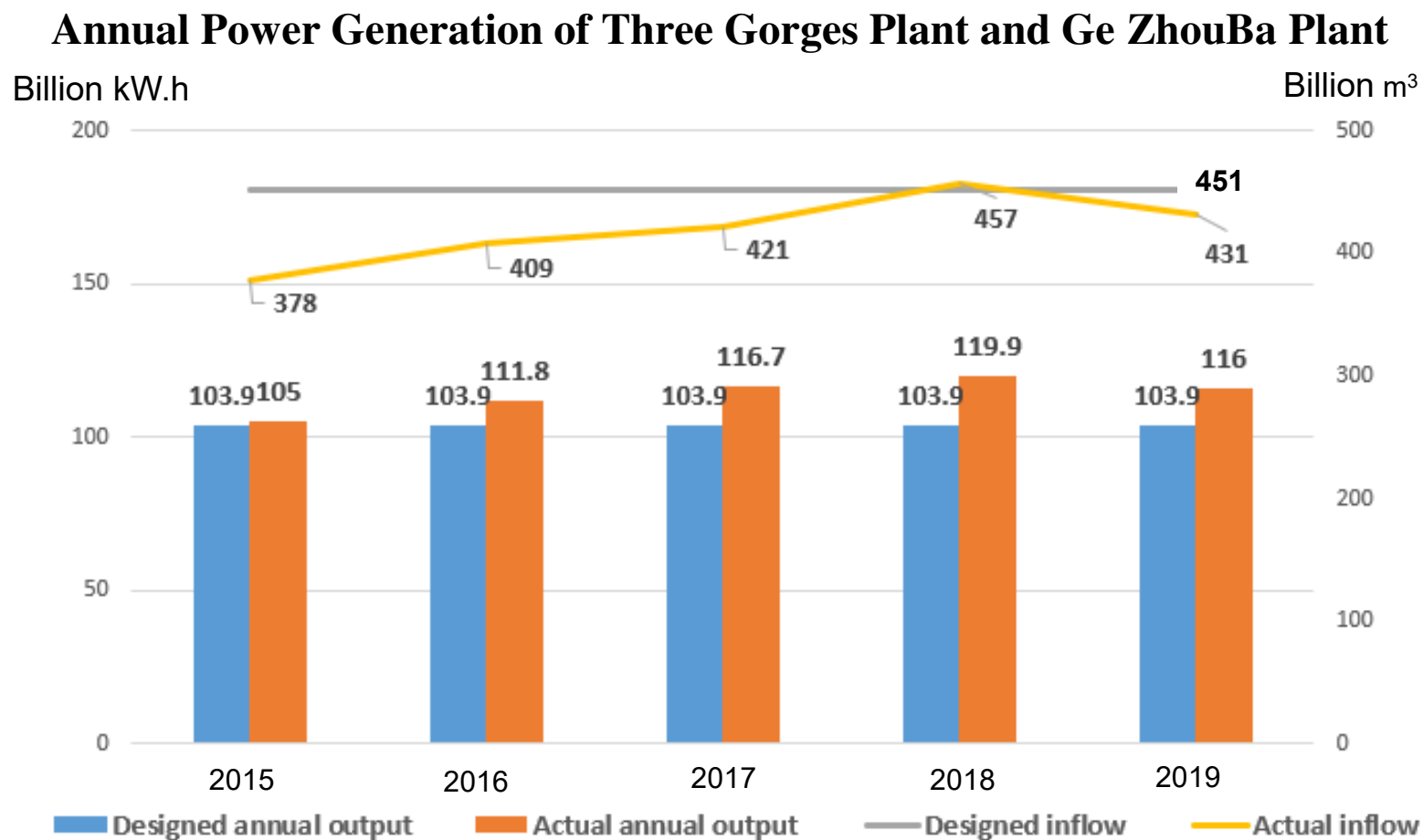
- 1000-ton Ships can Reach Chong Qing Directly from Shanz Hai
- Annual Capacity can Reach 50 million ton of Cargo from Chong Qing to HanKou
- Shipping Cost has Reduced by 35%~37% in the Yangtze River
- Promote the Development of Shipping Industry in the Tributaries





Power generation

From 2015 to 2019, the inflow of Three Gorges reservoir was **7% less** than the normal value, and the power generation of Three Gorges and Gezhouba is **9.6% more** than the designed power generation.



Ecology & Environmental Protection

By the end of 2019, total power generation of the 4 cascade hydropower plants had reached **2428.8TWh**, equivalent to **21 times** of Beijing's electricity consumption (2018), and **one third** of China's electricity consumption.



Be equal to burning coal **750 million tons**



Reduce CO₂ emission **2.0 billion tons**



Reduce SO₂ emission **21.5million tons**

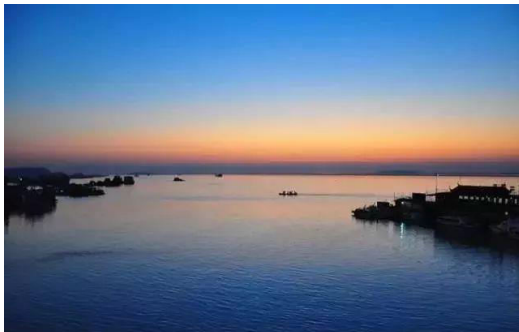




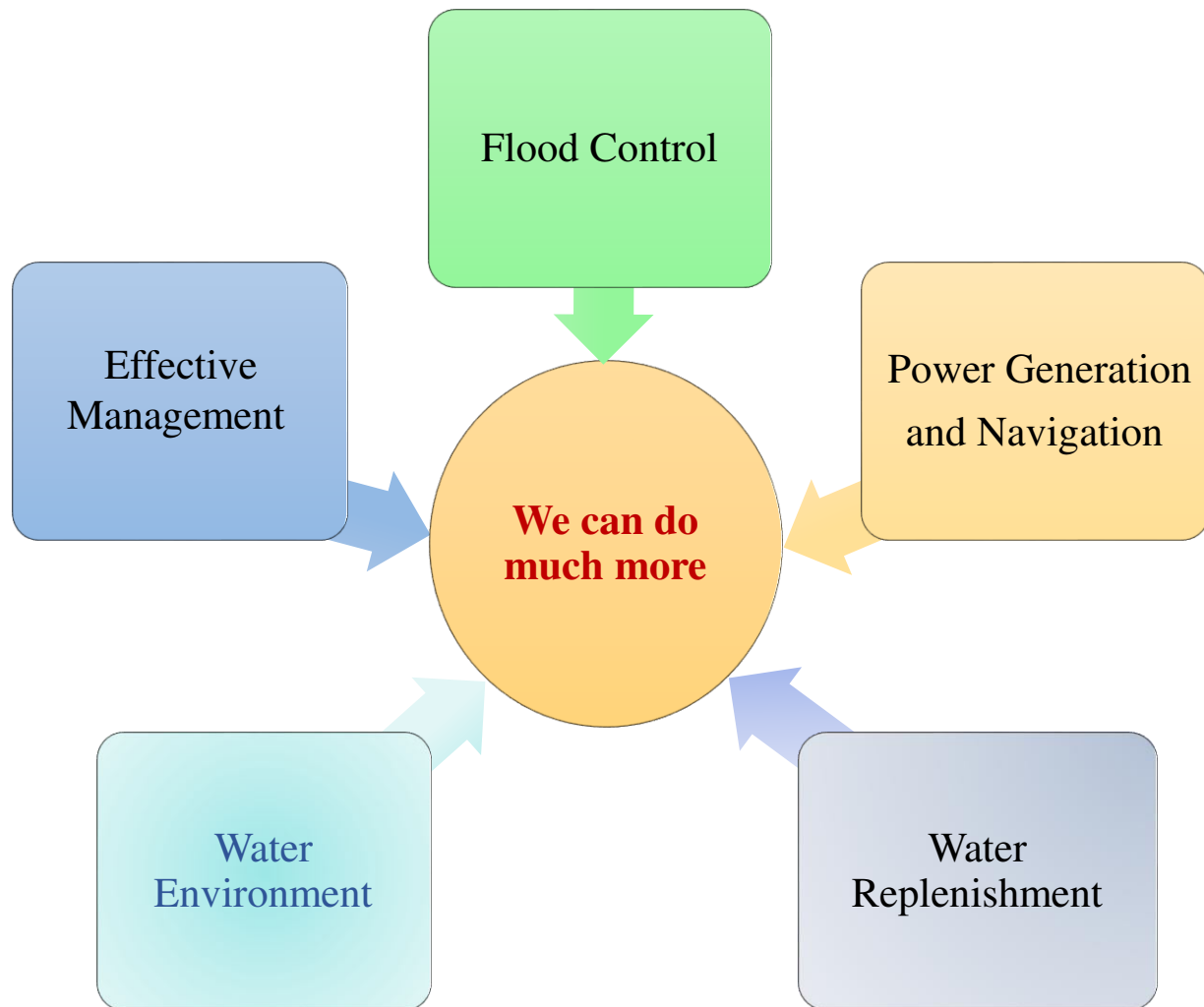
Water Replenishment

From 2010 to 2019, the Three Gorges Reservoir replenished **203.2** billion m³ of water to the downstream, the average annual replenishment volume is about **22.6** billion m³, **close to the capacity of an Albert lake**, and the average increase of downstream shipping depth is **0.95**m.

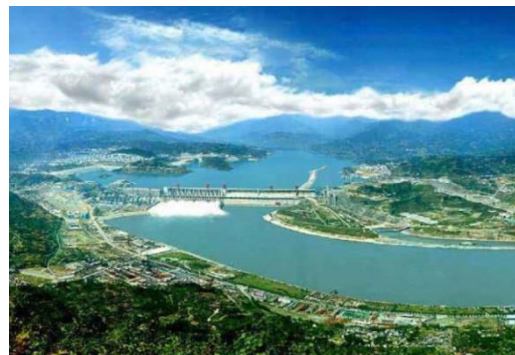
Statistical Table of Water Replenishment of Cascade Reservoirs CYPC



Year	Water Replenishment Days(d)	Replenishment Volume(billion m ³)	Average Additional Depth (m)
2010-2011	164	21.5	1.0
2011-2012	150	21.5	1.0
2012-2013	169	20.9	0.8
2013-2014	180	24.4	1.1
2014-2015	176	24.3	1.3
2015-2016	170	21.3	0.7
2016-2017	177	23.3	0.8
2017-2018	143	22.7	0.9
2018-2019	124	23.3	1.0



In the Future...



✓ Maintain Clean Energy Supply



✓ Improve the navigation condition.



✓ Improve flood control capacity



✓ Improve water environment



CYPC

THANKS

