

Norad Hydropower Development Program PowerChina's Perspective

*50-year Anniversary for the Hydropower Development (HPD) Program at NTNU
12th June 2023, Trondheim, Norway*



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HPD Chinese Students for Hydropower Development

CHEN Yunhua, 1993-1995 HDP.
Yalong Hydro, China.



WANG Hui, 1994-1996 HDP.
China Huadian, China.



WU Wenhao/1995-1997, HUANG Ziping/1996-1998, MAO Dawei/2004-2005 HDP. PowerChina, China.



1. HDP and AGN for Hydropower Development in China



**Project GU Zhaoqi, Visiting Scholar
in 1984~1985 in NTH (NTNU now)
"Hydropower Development in Norway"
Promoting hydropower technology exchanges
between China and Norway**



AGN (Advisor Group of Norway) in China (1984-2006)

No.	Hydropower Project	Province	River	Installed Capacity (MW)
1	Lubuge	Yunnan	Huangni	600
2	Xiaolangdi	Henan	Huanghe	1,800
3	Tiangshenqiao	Guizhou	Nanpan	2,500
4	Guangzhou	Guangdong	Luixi	1,200
5	Manwan	Yunnan	Lancang	1,500
6	Ming Tomb	Beijing	Yongding	800
7	Yantan	Guangxi	Hongshui	1,210
8	Longtan	Guangxi	Hongshui	4,200
9	Bailongtan	Guangxi	Hongshui	180
10	Ertan	Sichuan	Yalong	3,300
11	Pubugou	Sichuan	Dadu	3,300
12	Taipingyi	Sichuan	Minjiang	240
13	Jinping I	Sichuan	Yalong	3,000
14	Jinping II	Sichuan	Yalong	3,200
15	Yele	Sichuan	Nanya	660
16	Guandi	Sichuan	Yalong	1,800
17	Tianhuangping	Zhejiang	Daxi	1,800
18	Three Gorges	Hubei	Yangtze	18,200
19	Ziyili	Sichuan	Hujian	130
20	Xiluodu	Sichuan, Yunan	Jingsha	12,600
				Total 62.22GW



Lubuge Hydropower Project (1982-1990)
Rock-fill Dam 101m, 4x150=600MW, 110Mm³ reservoir

**AGN consultant services for training,
construction management and supervision of
the underground powerhouse and the tailrace
tunnel**

Ertan Hydropower Project (1991-2000),
Concrete Arch Dam 240m, 6x550=3300MW, 5800Mm³ reservoir

**AGN consultant services for training,
supervision of the underground powerhouse**

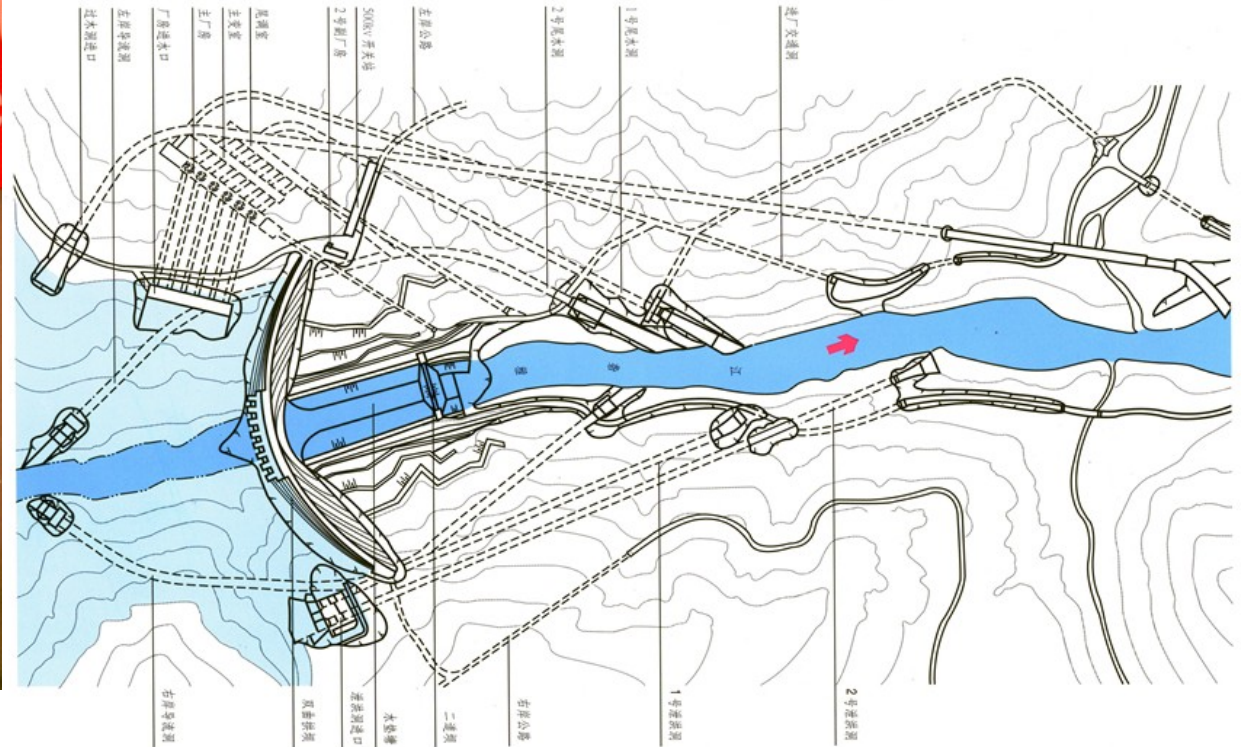
AGN (Advisor Group of Norway) in China

二滩水电项目土建国际招标合同签字仪式
SIGNING CEREMONY OF CIVIL WORKS CONTRACTS FOR ERTAN HYDROELECTRIC PROJECT



Prime Minister Participate the Signing Ceremony of Civil Works Contrats for Ertan HEP, 1991

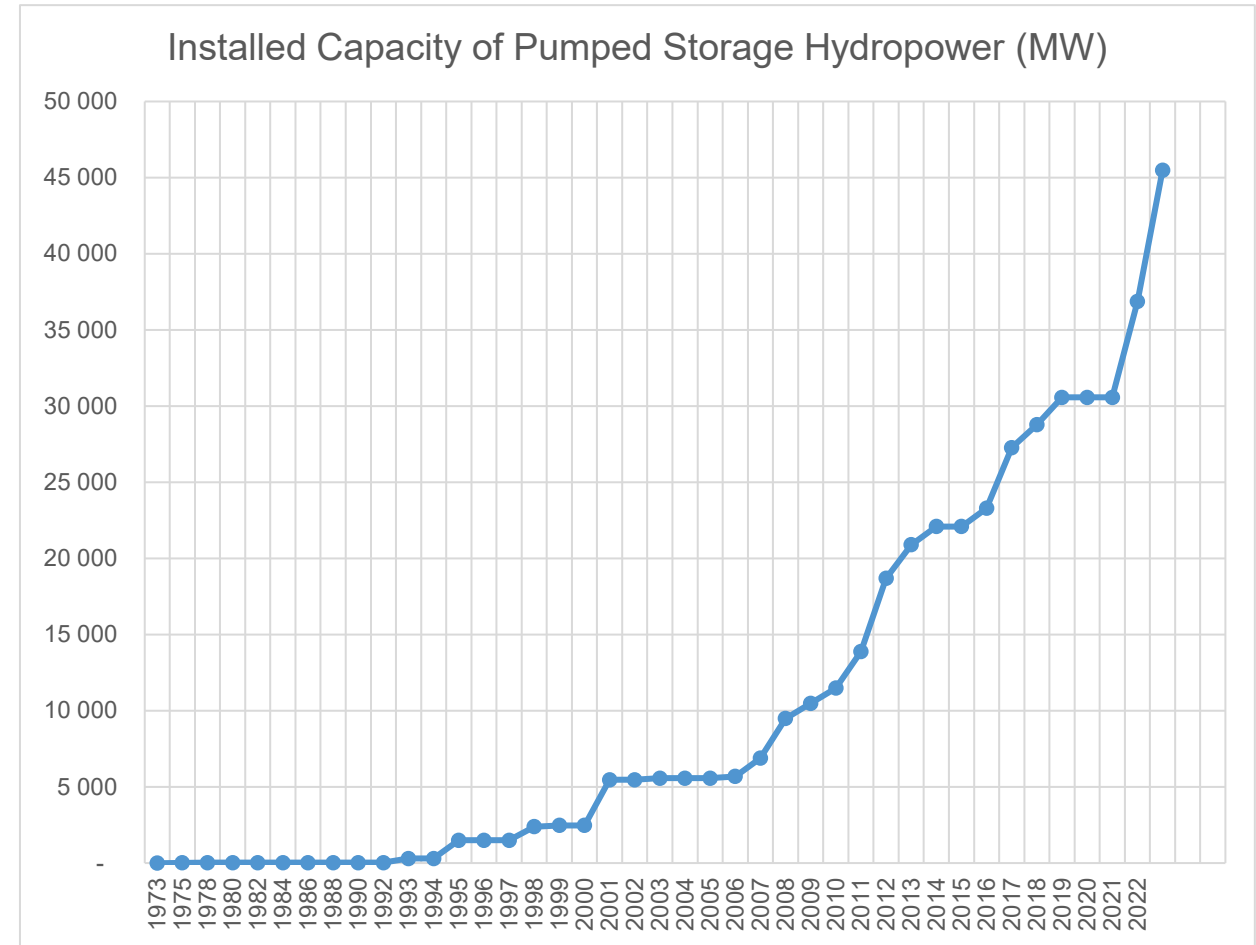
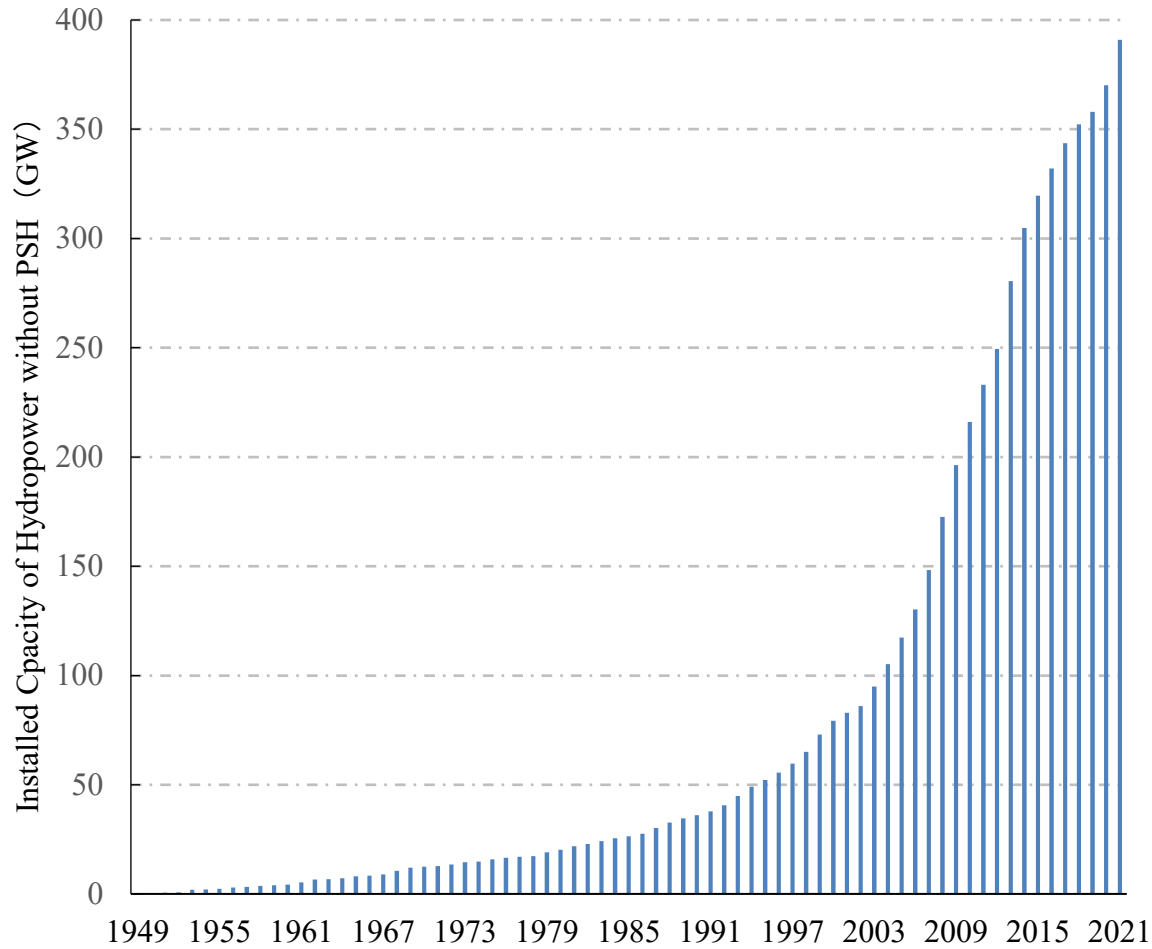
二滩电站枢纽总平面



Ertan Hydropower Project (1991-2000)

2. Hydropower in China and PowerChina

Progress of Hydropower (Incl. Pumped Storage Hydropower) Development in China



Conventional Hydropower

Total capacity in Operation:

Medium and Large-Scale Hydropower

(≥ 50 MW):

619 with total capacity 285.95GW

Small-Scale Hydropower (<50MW)

45,450 with total capacity 81.5GW

124 under construction with total capacity 47.3GW,

224 in planning stage with total capacity 110.7GW

17 in studying stage with total capacity 79.2GW

Long River Basin (140 rivers): 71%

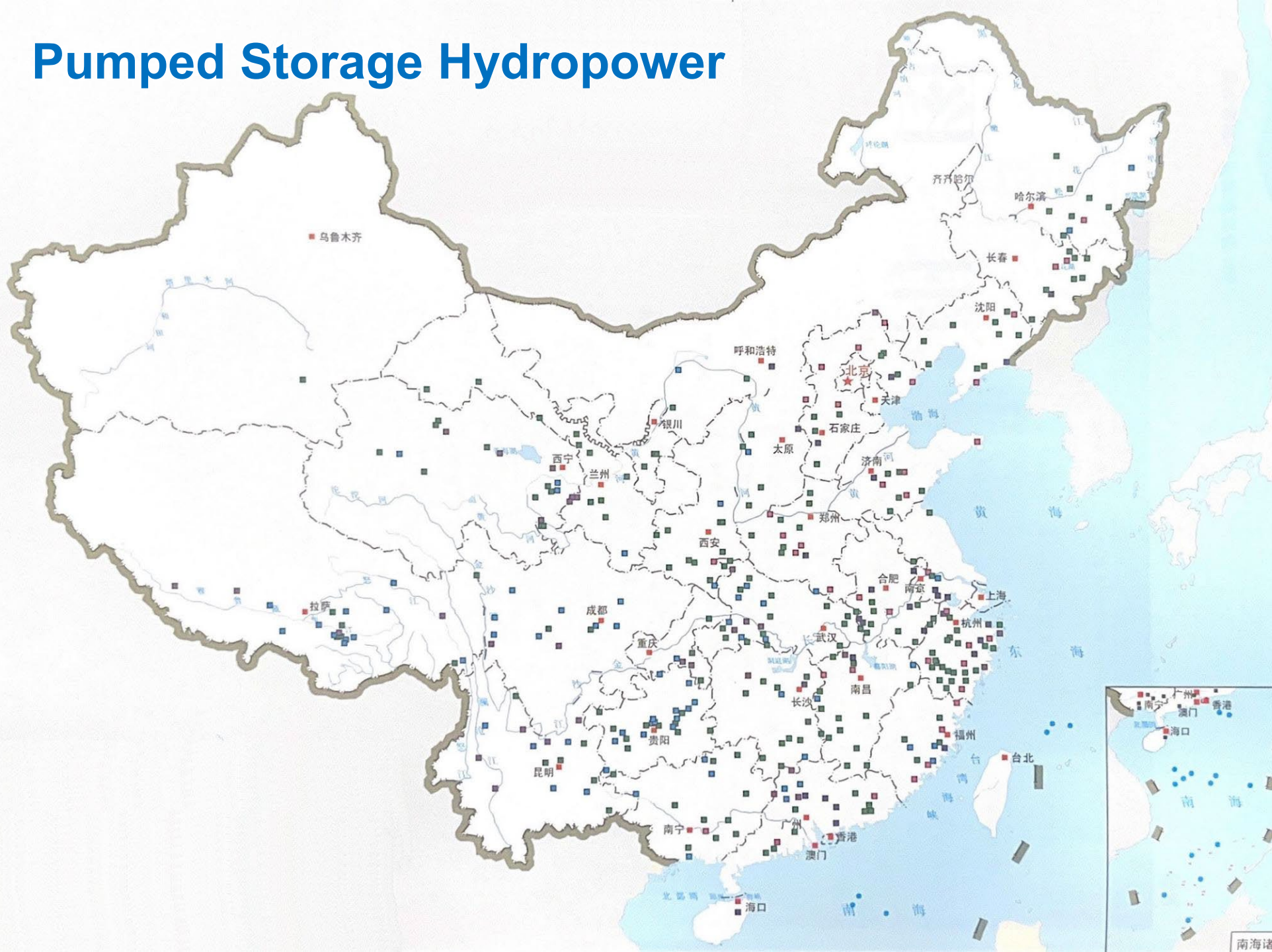
Yellow River Basin (26 rivers): 8.5%

Pearl River Basin (10 rivers): 8.5%

All the Other Rivers (113 rivers): 12%



Pumped Storage Hydropower



- ★ Capital
- Provincial Capital
- PSH in operation
- Under construction
- 14th 5-year Plan
- 15th 5-year Plan
- 16th 5-year Plan

**Present
PSH Installation**

➤ 45.39 GW

**Targets of
PSH Installation**

➤ 2025, 62GW

➤ 2030, 120GW

➤ 2050, >400GW

PowerChina's Contribution in Hydropower in China

PowerChina, Power The World

Hydropower Development in China by POWERCHINA

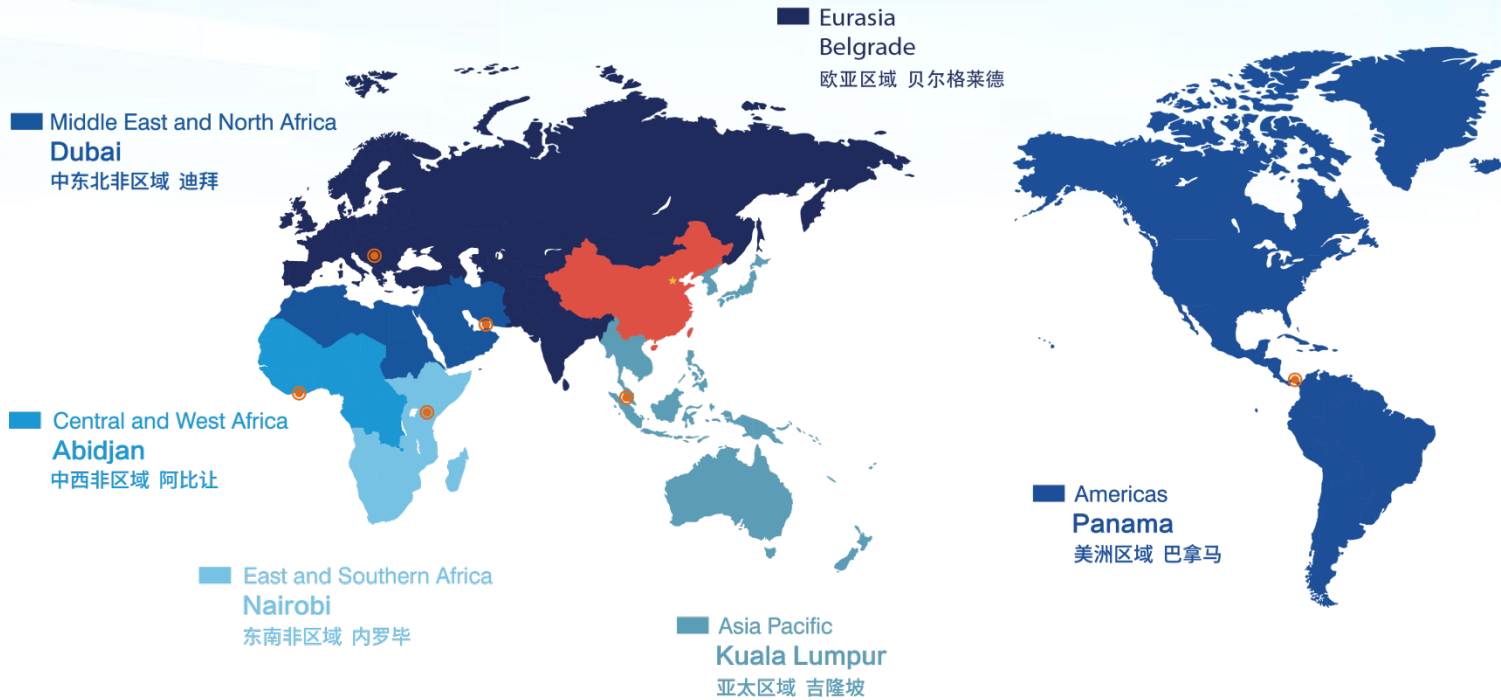
Construction Projects

Over **65%** of Hydropower Projects in China

Engineering Design and Supervision Projects

Over **80%** of Hydropower Projects in China

POWERCHINA Power The World



100

2022 Fortune 500
POWERCHINA ranked 100th



1 1st The Top 150 Global Design Firms (Rank 2022)

5 5th The Top 250 Global Contractors (Rank 2022)

6 6th The Top 250 International Contractors (Rank 2022)

16 16th The Top 225 International Design Firms (Rank 2022)

PowerChina Hydropower Projects in China



Three Gorges Hydropower Project

- The World's Largest Hydropower Station
- Installed Capacity – **22,400 MW**
- Dam Type – **Concrete Gravity Dam**
- Dam Height – **181 m**



Baihetan Hydropower Project

- The World's Second Largest Hydropower Station
- Installed Capacity – **16,000 MW**
- Dam Type – **Double Curve Arch Dam**
- Dam Height – **289 m**

PowerChina Hydropower Projects in China



Jinping Stage I Hydropower Project

- The World's Highest Arch Dam
- Installed Capacity – **3,600 MW**
- Dam Type – **Double Curve Arch Dam**
- Dam Height – **305 m**



Nuozhadu Hydropower Project

- The World's Highest Rockfill Dam (Completed)
- Installed Capacity – **5,850 MW**
- Dam Type – **Core-wall Rockfill Dam**
- Dam Height – **261.5 m**

PowerChina Hydropower Projects in China



Longtan Hydropower Project

- The World's Highest RCC Dam
- Installed Capacity – **6,300 MW**
- Dam Type – **RCC Gravity Dam**
- Dam Height – **216.5 m**



Shuangjiangkou Hydropower Project

- The World's Highest Rockfill Dam (Under Construction)
- Installed Capacity – **2,000 MW**
- Dam Type – **Core-wall Rockfill Dam**
- Dam Height – **312 m**

PowerChina Hydropower Projects in China



Jinping Stage II Hydropower Project

- Installed Capacity – **4,800 MW**
- Dam Type – **Concrete Gravity Dam**
- Dam Height – **49 m**



Ertan Hydropower Project

- Installed Capacity – **3,300 MW**
- Dam Type – **Double Curve Arch Dam**
- Dam Height – **240 m**

PowerChina Hydropower Projects in China



Fengning Pumped Storage Project

- Installed Capacity – **3,600 MW**
- Dam Type – **CFRD / Concrete Gravity Dam**
- Dam Height – **120.3m / 51.3m**



Meizhou Pumped Storage Project

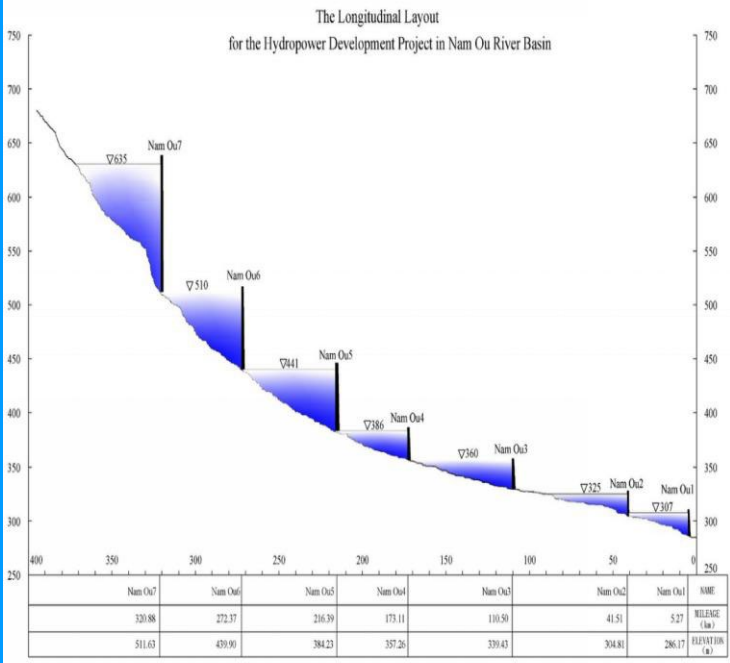
- Installed Capacity – **2,400 MW**
- Dam Type – **CFRD / RCC Gravity Dam**
- Dam Height – **60 m / 85m**

PowerChina International Hydropower Projects



Malaysia, Bakun Hydroelectric Project

- Installed Capacity – **2,400 MW**
- Dam Type – **CFRD**
- Dam Height – **205 m**



Lao PDR, Hydropower Project in Nam Ou River Basin

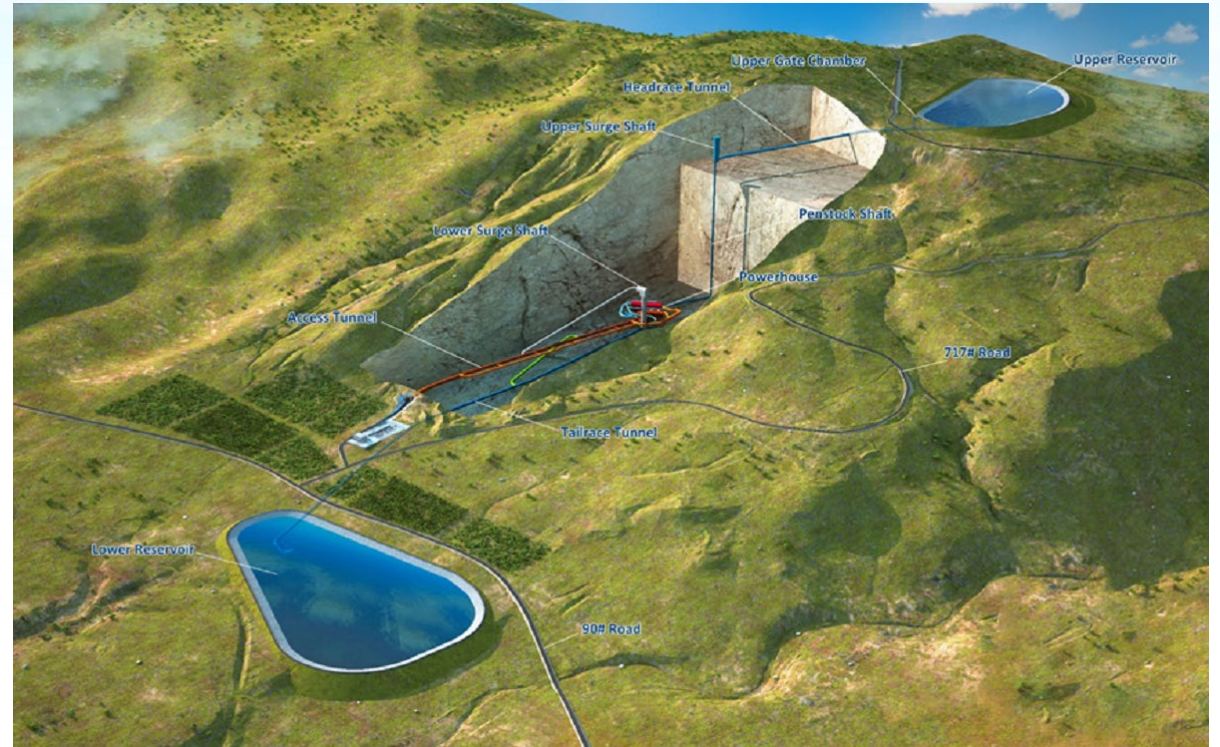
- Installed Capacity – **1,272 MW**
- Investment Volume – **2.74 billion USD**
- Condition of Contract – **BOT**

PowerChina International Hydropower Projects



Nepal, Upper Tamakoshi Hydropower Project

- Installed Capacity – **456 MW**
- Dam Type – **Concrete Gravity Dam**
- Dam Height – **27 m**



Israel, Kokhav Hayarden Pumped Storage Project

- Installed Capacity – **344 MW**
- Dam Type – **Earth Dam**
- Dam Height – **24.5 m / 21 m**

PowerChina International Hydropower Projects



Sudan, Merowe Hydropower Project

- Installed Capacity – **1,250 MW**
- Dam Type – **Multiple**
- Dam Height – **58.5 m**
- Crest Length – **9,800 m**



Ethiopia, Tekeze Hydropower Project

- Installed Capacity – **300 MW**
- Dam Type – **Double Curve Arch Dam**
- Dam Height – **188 m**

PowerChina International Hydropower Projects



Zambia, Kafue Gorge Lower Hydropower Project

- Installed Capacity – **750 MW**
- Dam Type – **RCC Gravity Dam**
- Dam Height – **139 m**

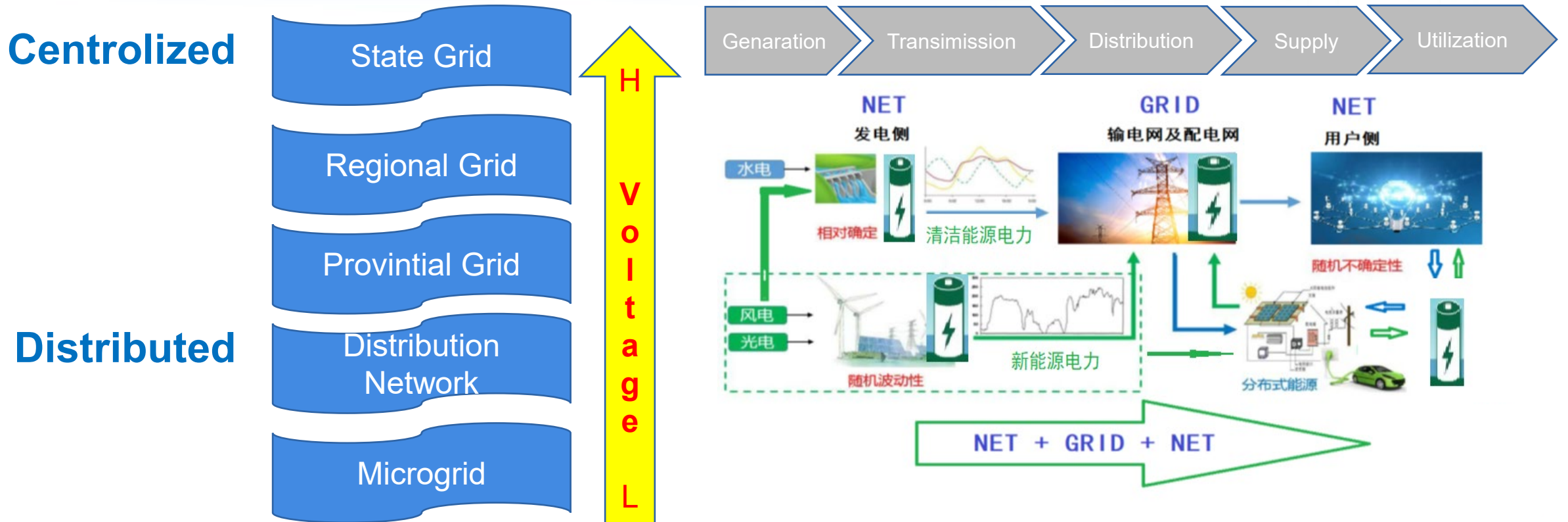


Tanzania, Julius Nyerere Hydropower Project

- Installed Capacity – **2,115 MW**
 - Dam Type – **RCC Gravity Dam**
 - Dam Height – **131 m**
- (Under Construction)

3. Hydropower to Meet Net Zero Targets

Planning Centralized vs Distributed Development of Renewable Energy in China, 2030



Renewable Energy Bases Planned in China, 2030

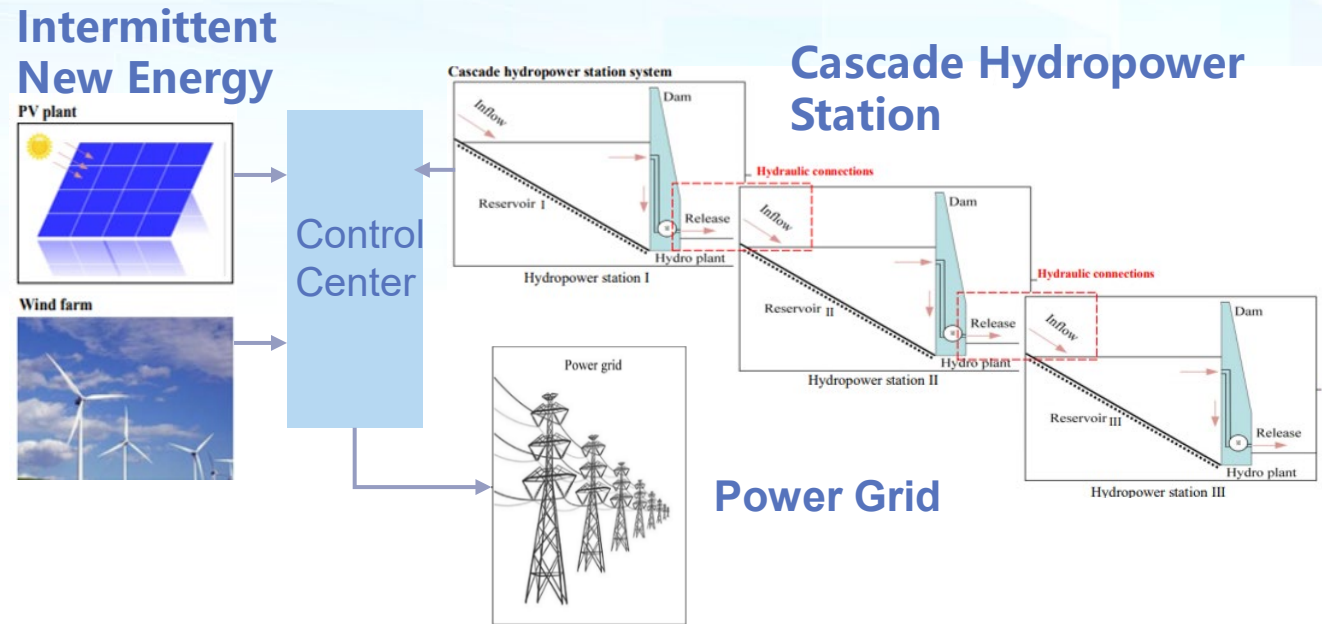
Wind, Solar

Hydro-Wind-Solar Hybrid System in River Basin

Off shore Wind



Hydro-Wind-Solar Hybrid System in River Basins, China



**The Yellow River
Upstream 1,280
MW Hydro + 850
MW Solar Hybrid
(Implemented)**



**Yalong River
30,000 MW
Wind & Solar +
30,000 Hydro
Hybrid (Planning)**



**Jinsha River
Downstream 46,460
MW Hydro + 15,180
MW Wind & Solar
Hybrid (Planning)**



**Wujiang River 13,000
MW Hydro &
Thermal + 10,000
MW Solar
(Implemented)**



**Lantsang River
40,000 MW Hydro +
40,000 MW Wind &
Solar Hybrid
(Planning)**

4. Cooperation via China Society for Hydropower Engineering



Found in 1980. 39,000 individual members
173 institute members, 37 technical committee, 1
working committee, 2 professional associations

International Forum of CSHE (IF-CSHE)

- ✓ Platform for international business cooperation in sustainable hydropower and new energy developments;
- ✓ Bridge Chinese and international societies in academic and technical communication in hydropower;
- ✓ Involve in the role, challenges and opportunities of hydropower in clean energy transition;
- ✓ Sponsor, undertake and co-organize international hydropower conferences;
- ✓ Organize study of investment and financing, social impact, environment and ecosystem, engineering design and construction, operation, maintenance, retrofitting and other issues in hydropower development;
- ✓ Promote internationalization of the Chinese standards;
- ✓ Selection and promotion of Chinese young professionals with international vision;
- ✓ Assist CSHE on evaluation of overseas hydropower project awards.

2023 International Hydropower Development Conference



Organizations:

- IRENA, IHA, WB,
- CSHE and NEA of China

Numbers about the conference:

- 230 participants attend in person
- 350 online participants
- 1.2 million online audiences
- 5.4 million live-photo views

Key topics: **Pumped storage hydropower (PSH) will be the key pillar of future energy system**

- ✓ Essential role of hydropower in clean energy transition and capacity additions required to meet net zero targets;
- ✓ High technology development in cost saving, large-scale, long lifecycle, environmentally friendly, capability to balance the VRES;
- ✓ Large-scale grid connection of renewable energies;
- ✓ Planning of PSH to meet Net Zero targets.

Thank You !

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