WATER ENERGY NEXUS : CASE OF CHINA

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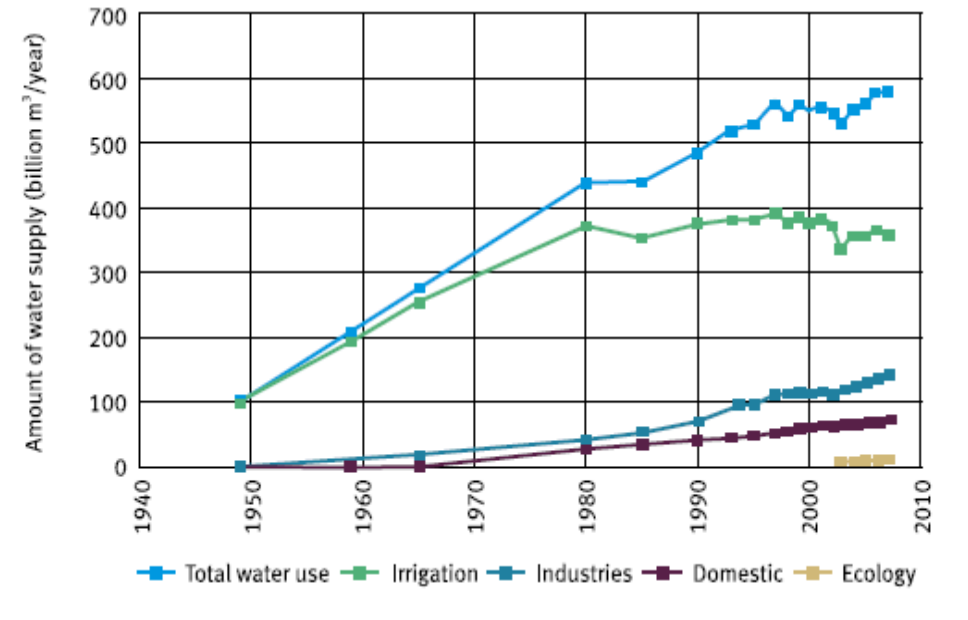
WHAT IS DRIVING THE WATER ENERGY NEXUS IN CHINA

- UNEVEN DISTRIBUTION OF WATER RESOURCES. NORTH HAS 60% OF POPULATION BUT ONLY 20% OF WATER.
- EXTENSIVE USE OF GROUND WATER IN NORTHERN CHINA. 35% OF AGRICULTURE WATER DEMAND IS MET WITH GROUND WATER.
- INEFFICIENT USE OF WATER IN AGRICULTURE. (53% OF WATER USE EFFICIENCY)
- HIGH INCIDENCE OF WATER POLLUTION. HALF OF RIVERS ARE NOT SUITABLE FOR HUMAN CONSUMPTION.
- EXTREME WATER STRESS IN PARTS OF NORTHERN PRC.
- ENERGY USE IN WATER SUPPLY IS ABOUT 4% (200TWH) OF ELECTRICITY CONSUMPTION.

- HIGH ENERGY INTENSITY OF PRC ECONOMY DUE TO HEAVY DEPENDENCE ON HEAVY INDUSTRIES.
- COAL DOMINATED ENERGY SECTOR. (65% OF PRIMARY ENERGY SUPPLY AND 67% OF ELECTRICITY GENERATION).
- WATER USE IN COAL MINING AND COAL WASHING IS SIGNIFICANT SOURCE OF WATER POLLUTION
- LOCATION OF COAL MINING IN WATER STRESS REGIONS IN WESTERN & NORTHERN CHINA.
- WATER USE IN COAL CHEMICAL INDUSTRY.
- WATER USE IN THERMAL POWER GENERATION
- POTENTIAL WATER CONTAMINATION DUE TO SHALE GAS DEVELOPMENT

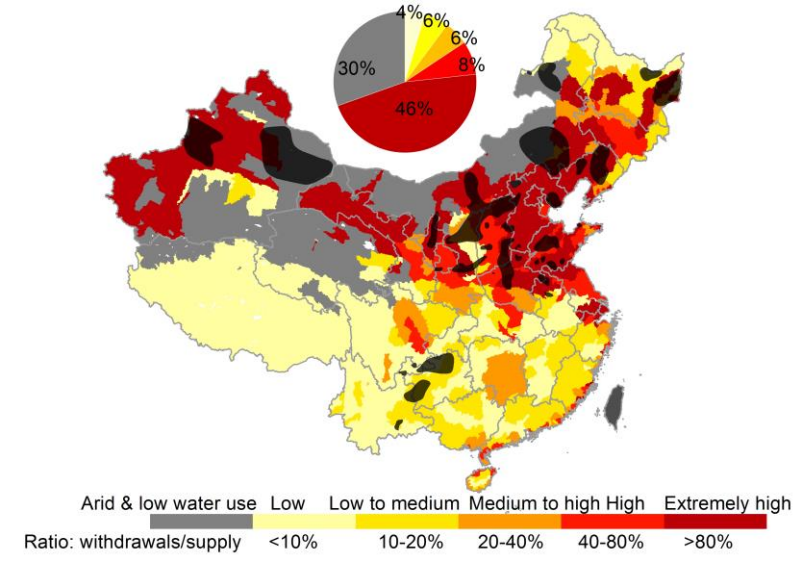
WATER USE AND WATER AVAILABILITY IN PRC

	Water Availability (bcm)			Water Withdrawals (bcm)			Water Use Intensity (%)		
Region	**Surface**	**Ground**	**Total[a]**	**Surface**	**Ground**	**Total[b]**	**Surface**	**Ground**	**Total**
North	381.1	230.2	465.8	175.0	98.9	278.0	45.9	43.0	60.0
South	2,245.3	544.2	2,260.8	317.0	12.8	331.5	14.1	2.3	14.7
Total	**2,626.4**	**774.4**	**2,726.6**	**492.0**	**111.7**	**609.5**	**18.7**	**14.4**	**22.4**



- Agriculture accounts for 65% of water withdrawals.
- Water withdrawal by energy sector is about 60 bcm or 10% of total withdrawal and accounts for half of industrial water withdrawal.
- The water consumption of energy sector is about 15 bcm or 25% of water withdrawal.
- Cooling of thermal power plants is the biggest use of water in energy sector.
- Although coal mining does not use lot of water (10 bcm) it is a major cause for water pollution.

WATER USE IN COAL INDUSTRY



COAL Mining

- PRC Accounts for 45% of global coal production.
- Coal mining also results in highly polluted "produced water" from dewatering of coal seams.
- In addition mine trailings can leach into surface water bodies and ground water.
- Fresh water requirement for coal mining is about 2 bcm and produce water is more than 6 bcm.

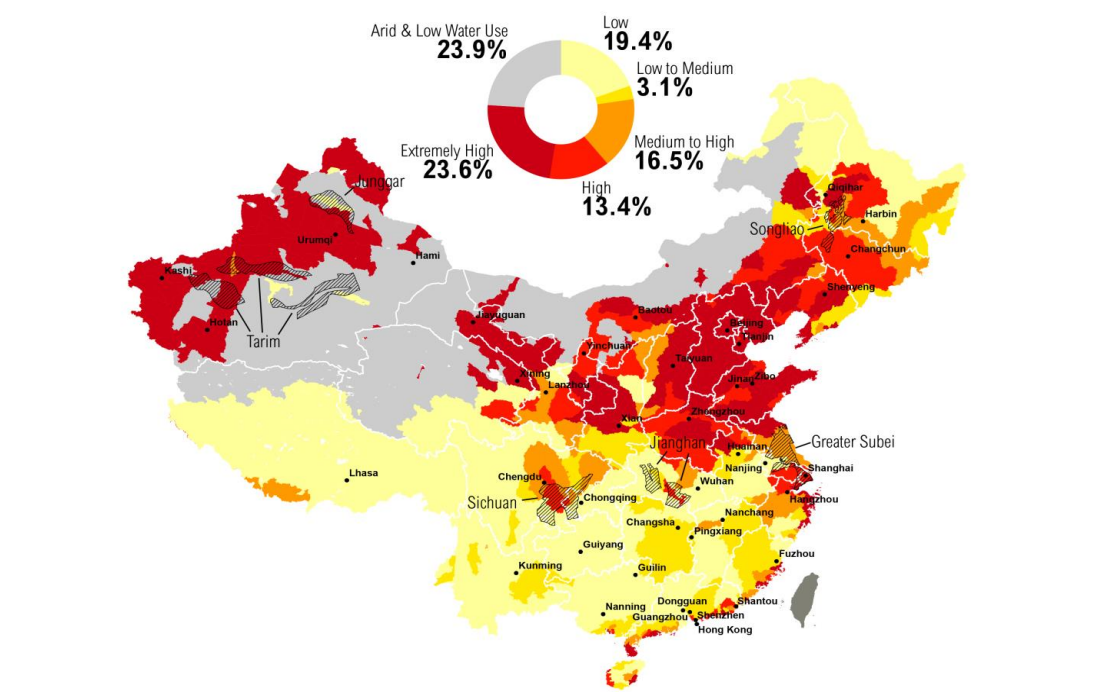
COAL WASHING

- About 50% of coal mined in China is subject to coal washing.
- Coal washing requires about 5 bcm of water and result in highly polluted waste water.

Coal Gasification, Liquification and Coal Chemical Industry

- China is making large investments in Coal chemical industry including coal to gas and coal to liquid.
- These plants are located in water stress regions and is expected to require 10 bcm of water and will produce highly polluted water water of 1 bcm by 2020.

WATER USE IN OIL & GAS SECTOR



CHINA SHALE PLAYS VS **BASELINE WATER STRESS**

Oil Production

- The water use in conventional oil and gas production is insignificant. It is mainly related to the pressure build up of oil wells and amounts to 0.3 bcm per year.
- However, the oil production also results in highly polluted “produced water”. This can be recycled to pressurizing oil wells.

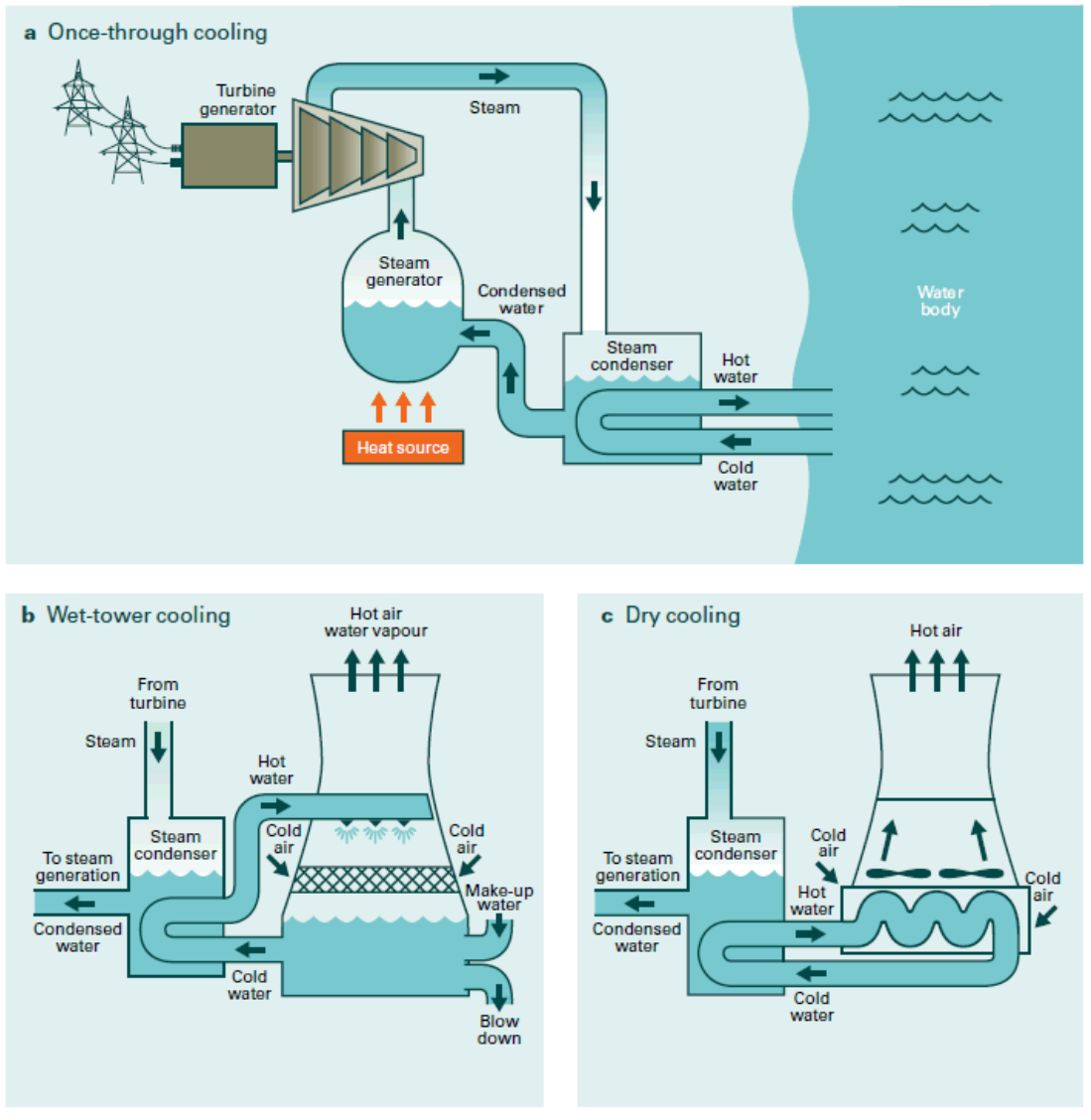
Oil Refining

- Oil refineries require water (0.1 bcm) for cooling, producing steam and as feed stock for chemical processes.
- Water use can be optimized by recycling the water used for cooling.

Natural Gas

- The conventional natural gas production requires minimum amount of water
- Shale gas need extensive amount of water and also can pollute the ground water aquifiers.

WATER USE IN THERMAL POWER PLANTS



Open Loop Cooling

- Used in coastal power plants and power plants located close to natural water bodies.
- Water withdrawal is high and may affect the aquatic life of natural water bodies.

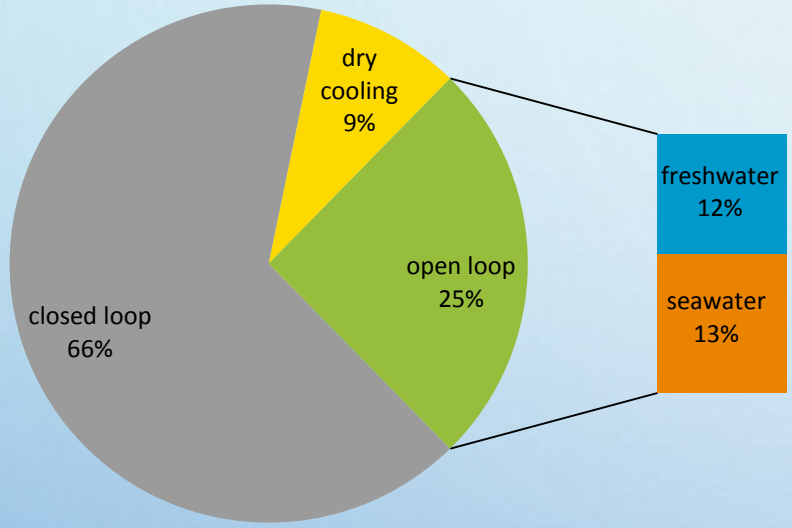
Close Loop Cooling

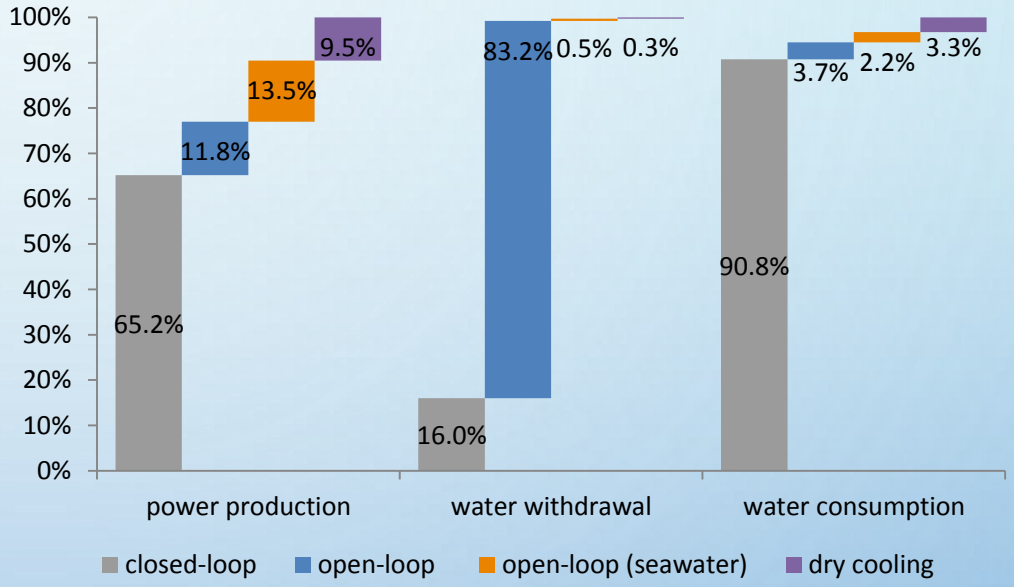
- Water withdrawal is less but water consumption is high (10 times that of open loop) due to evaporative losses in cooling towers.
- Most prevalent form of cooling in China

Dry (Air) Cooling

- Used in arid areas in North West China.
- Plant efficiency is affected due to high auxiliary consumption.
- Capital cost is high.

THERMAL POWER PLANT COOLING TECHNOLOGIES USED IN CHINA

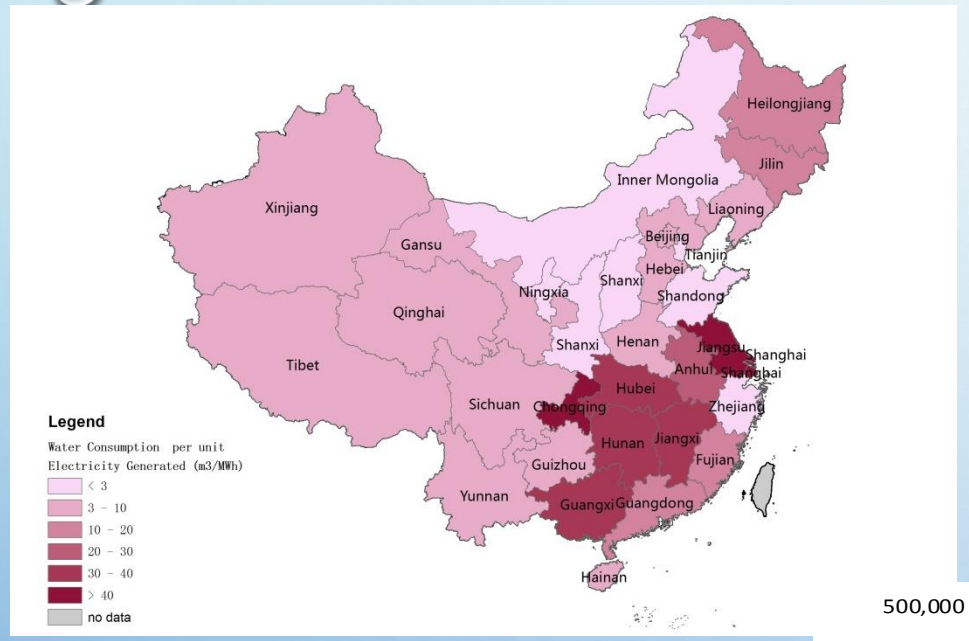


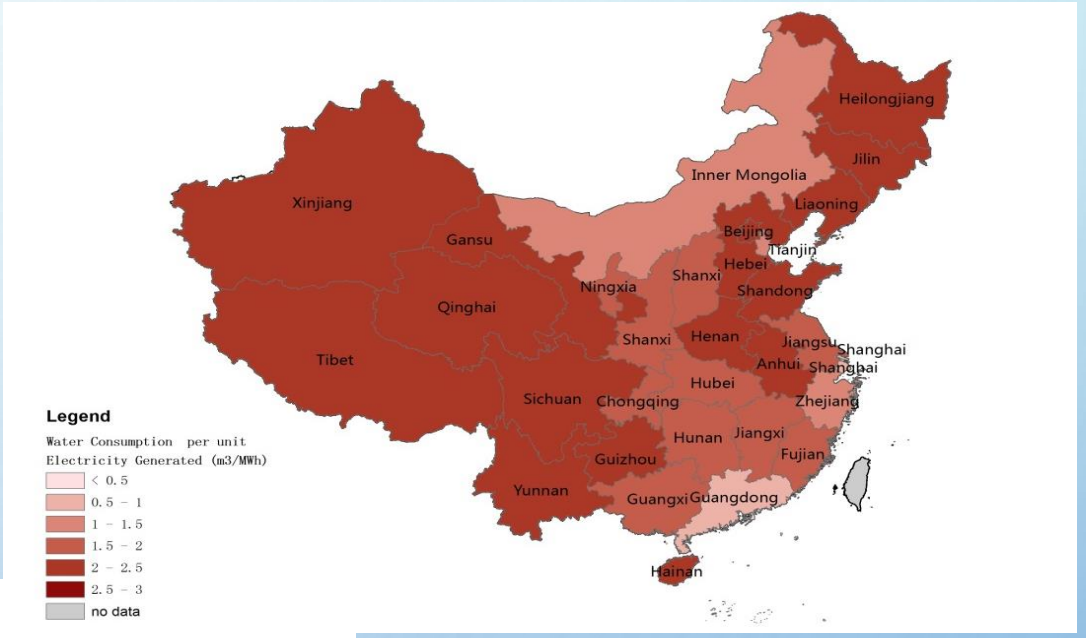


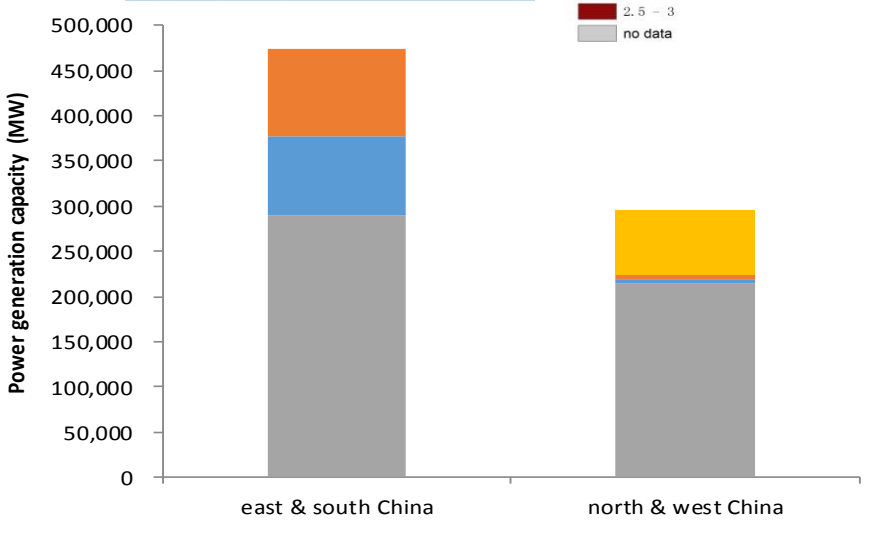
- Most prevalent cooling technology in China is closed loop cooling.
- About half of the thermal power plants using open loop cooling uses seawater for cooling.
- The dry cooling is used to a certain extent in North and Western China

REGIONAL VARIATIONS IN WATER USE IN THERMAL POWER

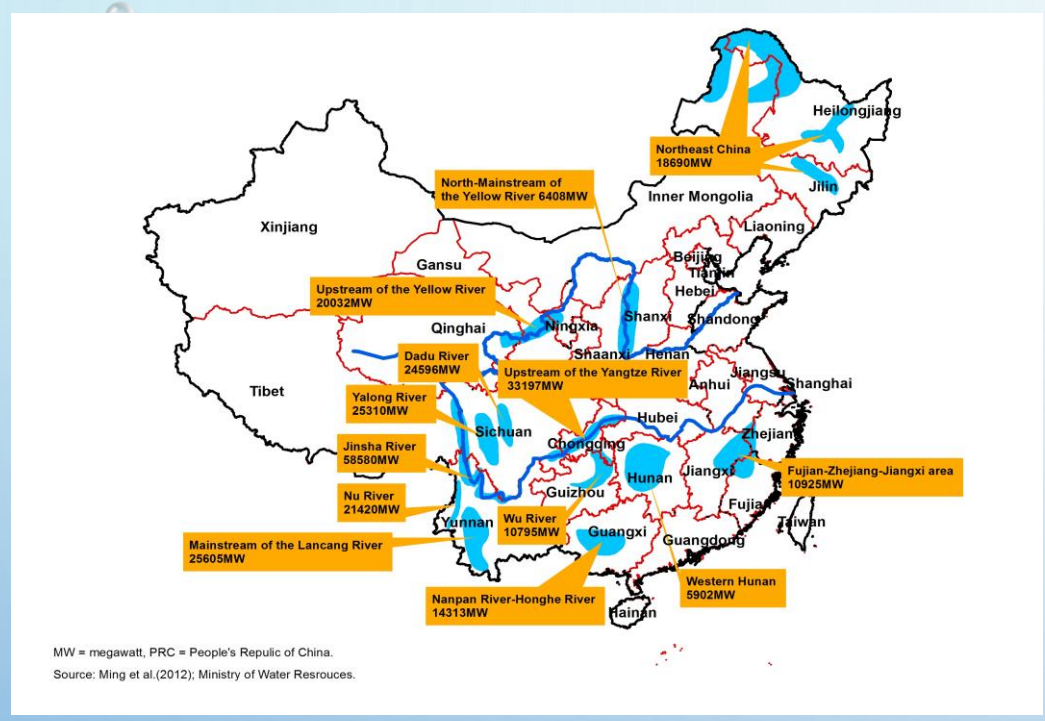
Water withdrawal intensity







HYDRO POWER DEVELOPMENT IN PRC



- China has the world's largest hydropower capacity of more than 300 GW.
- Mostly located in the Central and South East of the country.
- Hydropower does not consume or pollute water.
- However, large quantities of water is withdrawn, stored or diverted.
- There are locational and temporal impacts.
- Aquatic Eco System continuity is disrupted and bio diversity affected.
- Environment impacts during construction.
- Impacts on indigenous rural people.

RECOMMENDATIONS TOWARDS SUSTAINABLE WATER USE IN ENERGY SECTOR

- INTEGRATED WATER USE AND ENERGY PLANNING AT THE NATIONAL LEVEL
- STRENGTHEN THE CAPACITY OF WATER SECTOR REGULATORY AGENCIES VIS A VIS LARGE STATE OWNED ENERGY COMPANIES.
- DIVERSIFY THE ENERGY SUPPLY MIX AWAY FROM COAL
- USE OF MARKET BASED INSTRUMENTS FOR WATER RESOURCE ALLOCATION
- IMPROVED DATA COLLECTION OF WATER USE IN ENERGY SECTOR