

The background is a light blue gradient with several realistic water droplets of various sizes scattered across it. The droplets have highlights and shadows, giving them a three-dimensional appearance.

WATER ENERGY NEXUS : CASE OF CHINA

DR. PRADEEP PERERA

PRINCIPAL ENERGY SPECIALIST

ASIAN DEVELOPMENT BANK

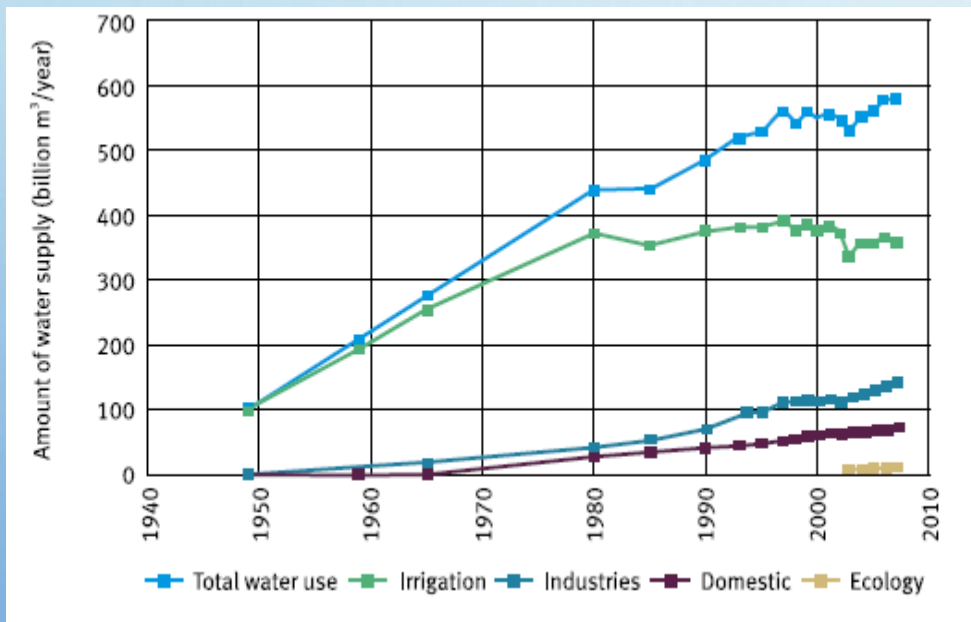
WHAT IS DRIVING THE WATER ENERGY NEXUS IN CHINA

- 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

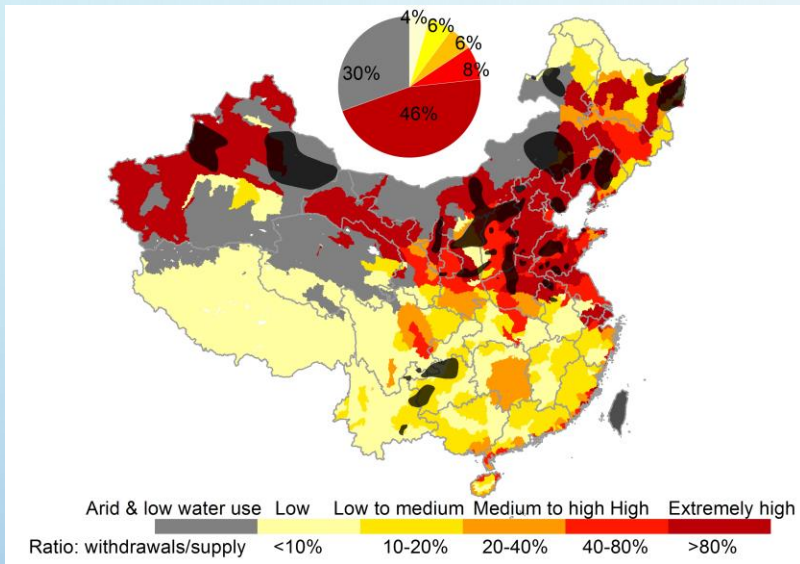
WATER USE AND WATER AVAILABILITY IN PRC

Region	Water Availability (bcm)			Water Withdrawals (bcm)			Water Use Intensity (%)		
	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.

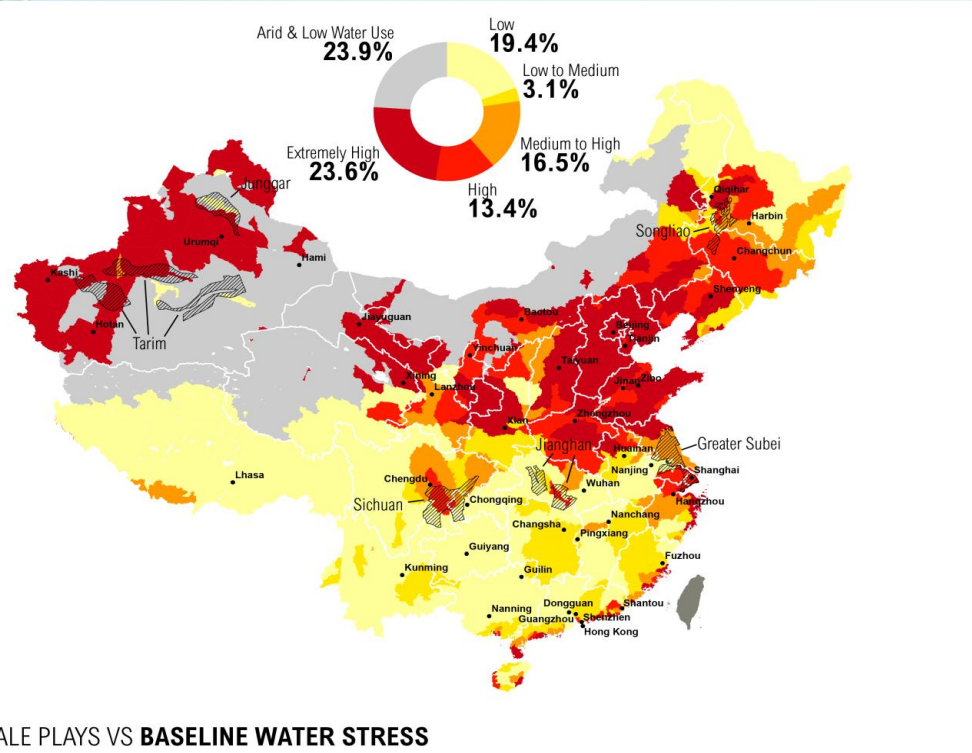
COAL WASHING

- 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, Liquefaction 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 of 1 bcm by 2020.

WATER USE IN OIL & GAS SECTOR



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.

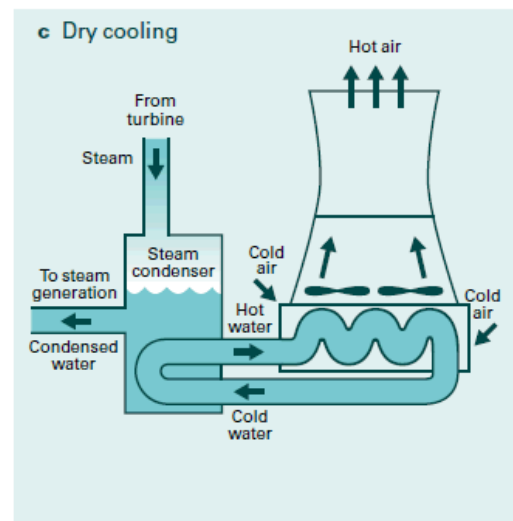
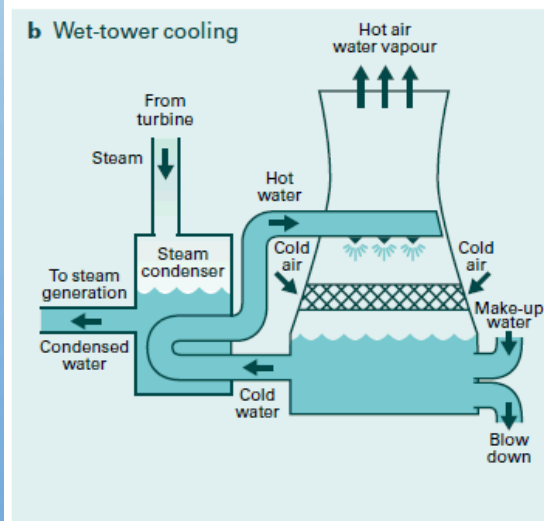
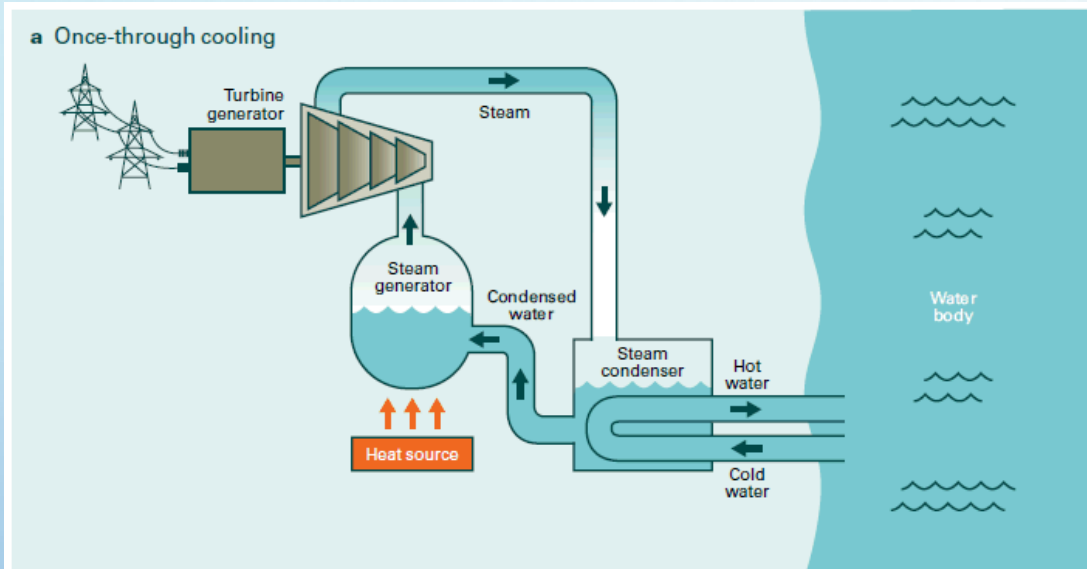
Oil Refining

- 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 aquifers.

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.

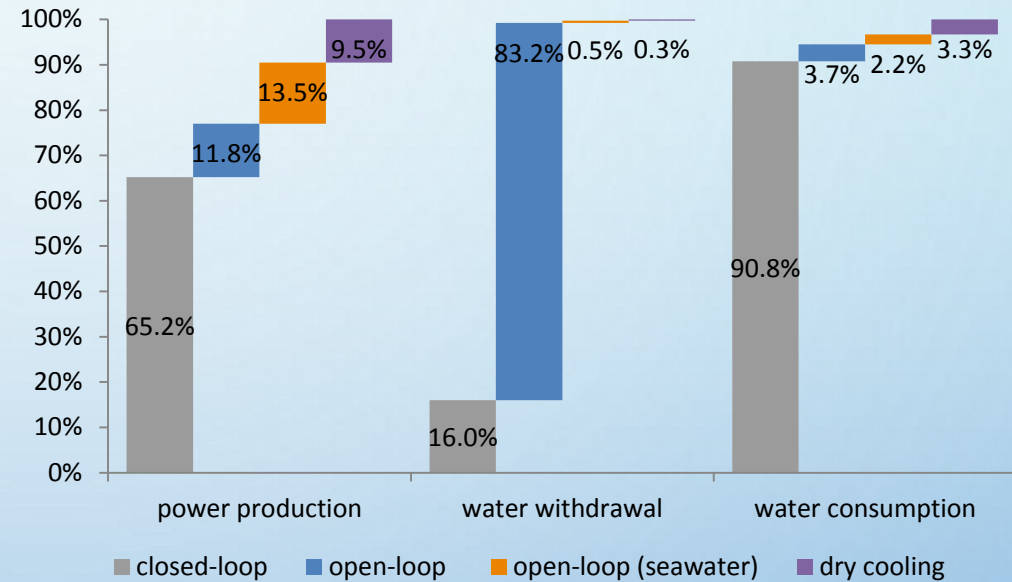
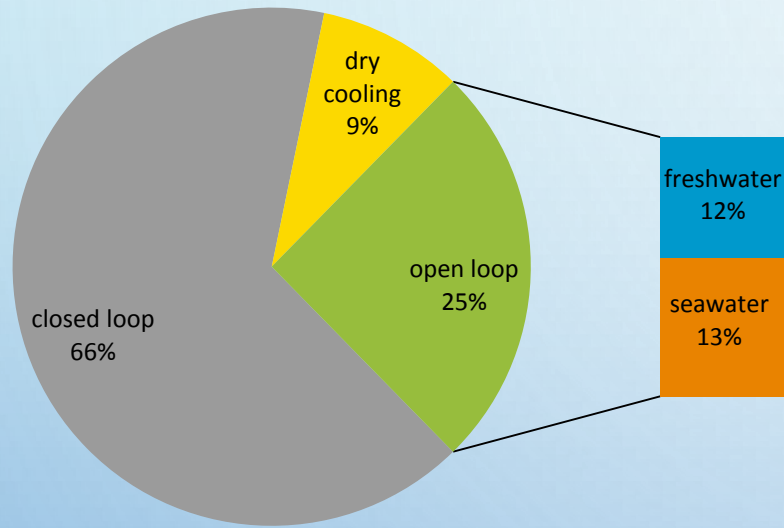
Close Loop Cooling

- 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.

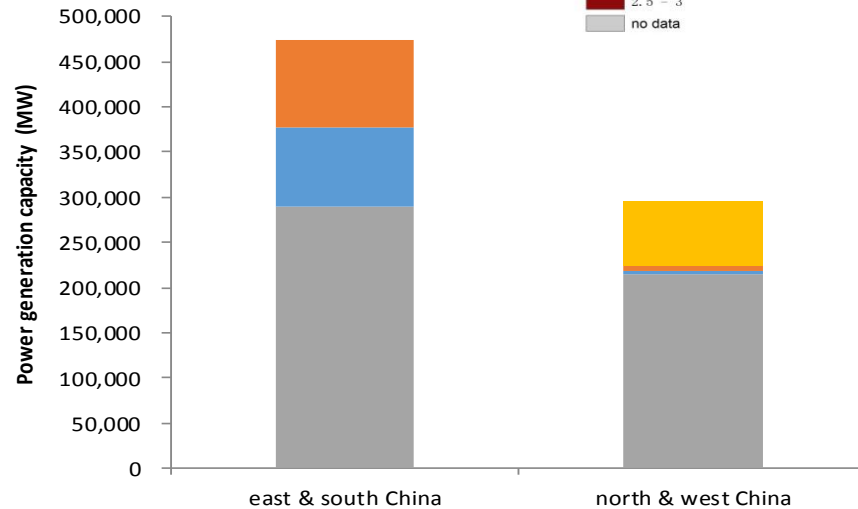
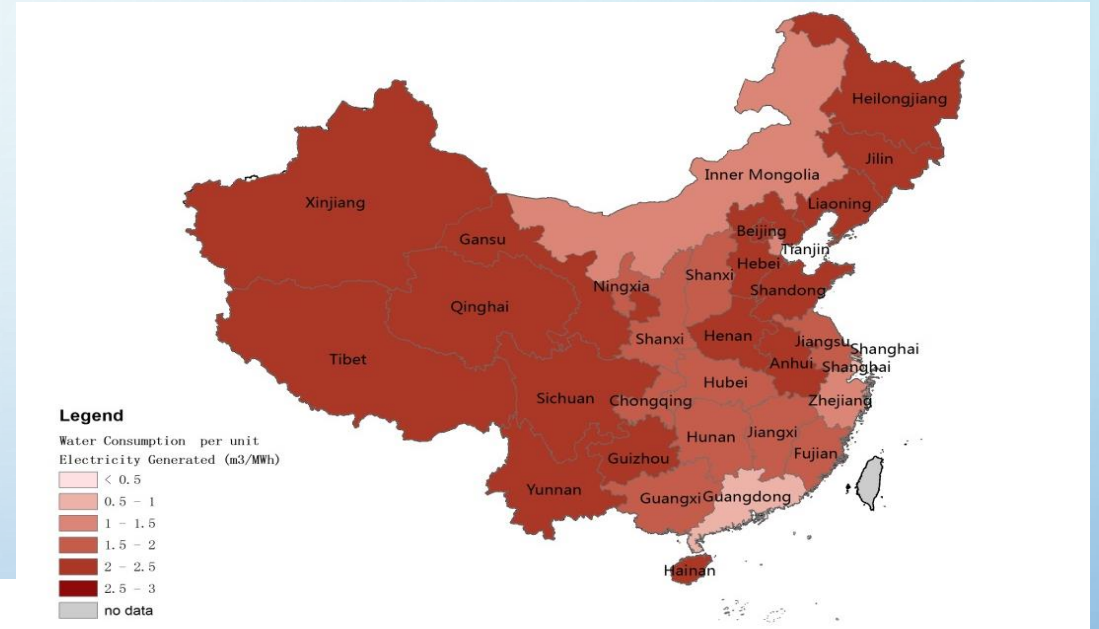
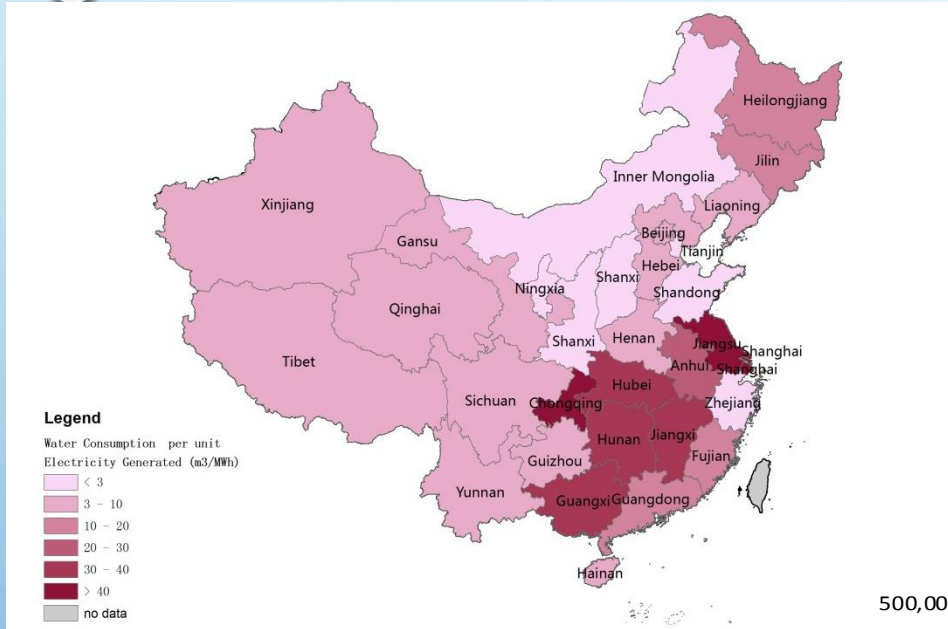
THERMAL POWER PLANT COOLING TECHNOLOGIES USED IN CHINA



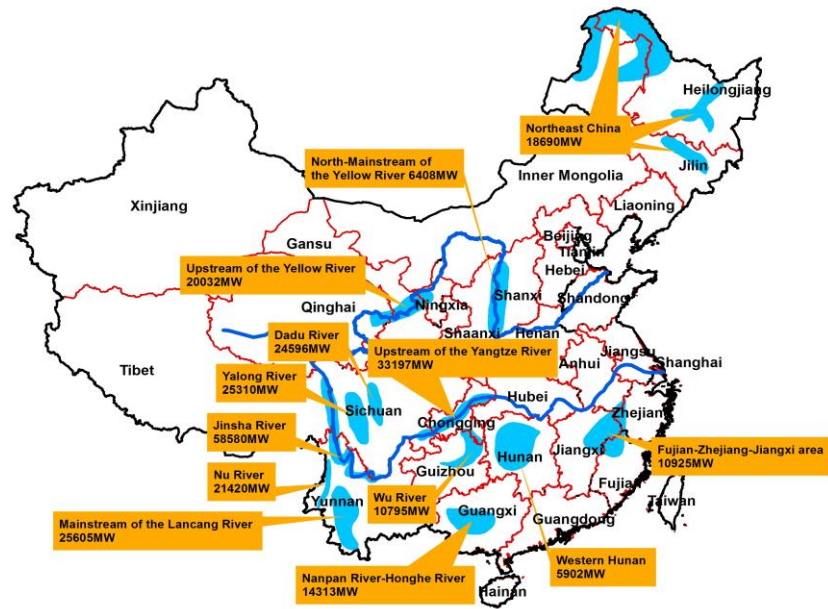
- Most prevalent cooling technology in China is closed loop cooling.
- About half of the thermal power plants using open loop cooling uses seawater for cooling.
- The dry cooling is used to a certain extent in North and Western China

REGIONAL VARIATIONS IN WATER USE IN THERMAL POWER

Water withdrawal intensity



HYDRO POWER DEVELOPMENT IN PRC



MW = megawatt, PRC = People's Republic of China.
Source: Ming et al.(2012); Ministry of Water Resources.

- 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