

# **WATER ENERGY NEXUS : CASE OF CHINA**

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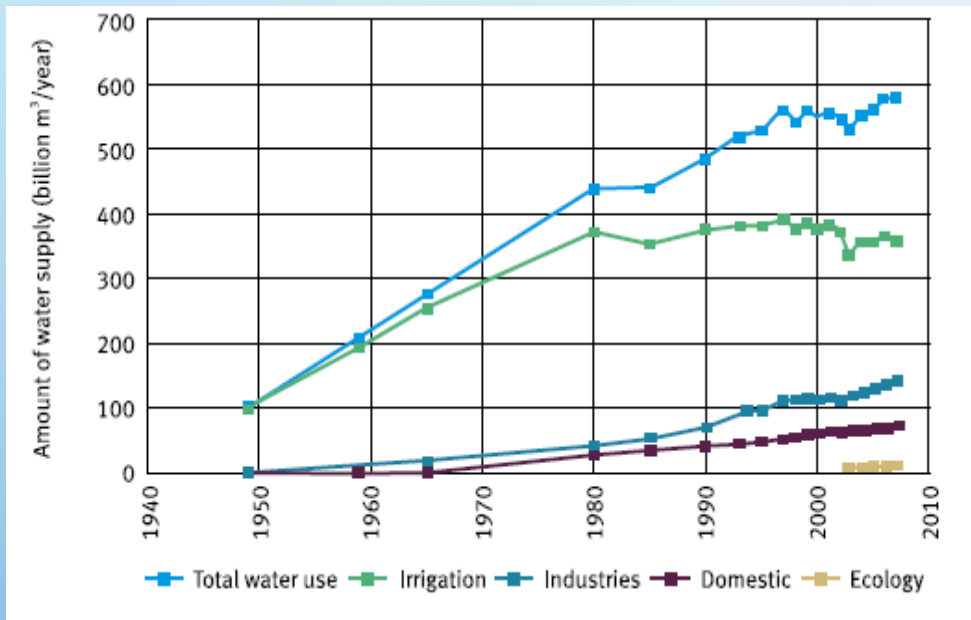
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# **OBJECTIVE AND CONTEXT FOR THE STUDY**

- **CLIMATE CHANGE, URBANIZATION AND RAPID INDUSTRIALIZATION IS MAKING INTERPLAY BETWEEN WATER AND ENERGY CRITICAL CRITICAL.**
- **TO HIGHLIGHT THE IMPORTANCE OF INTEGRATED APPROACH TO DECISION MAKING.**
- **EXPLOIT OPPORTUNITIES FROM COORDINATED DEVELOPMENT OF TWO SECTORS.**
- **EXPLORE NEW REGULATORY TOOLS, MARKET BASED INSTRUMENTS AS WELL AS TECHNOLOGY CHOICES TO ACHIEVE OPTIMUM OUTCOMES TOWARDS ECOLOGICAL CIVILIZATION AS ASPIRED BY PRC GOVERNMENT.**

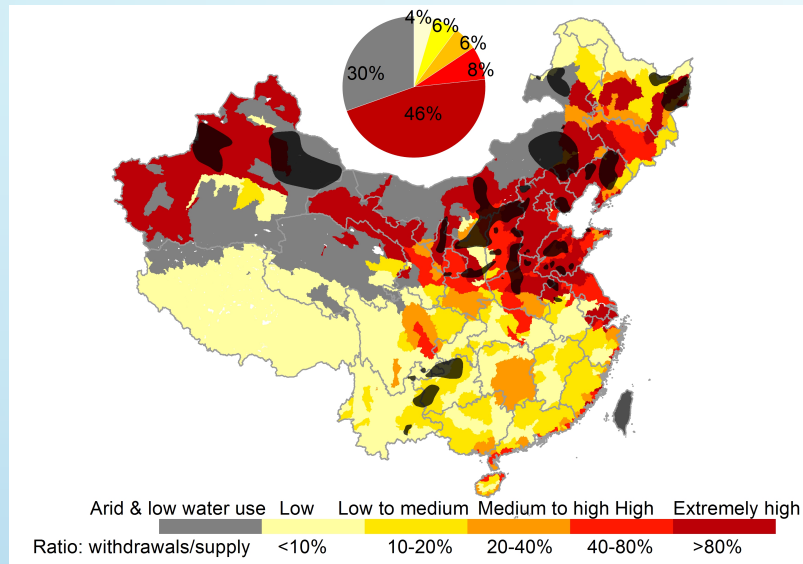
# WATER USE AND WATER AVAILABILITY IN PRC

Region	Water Availability (bcm)			Water Withdrawals (bcm)			Water Use Intensity (%)		
	Surface	Ground	Total <sup>a</sup>	Surface	Ground	Total <sup>b</sup>	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
<b>Total</b>	<b>2,626.4</b>	<b>774.4</b>	<b>2,726.6</b>	<b>492.0</b>	<b>111.7</b>	<b>609.5</b>	<b>18.7</b>	<b>14.4</b>	<b>22.4</b>



- 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.

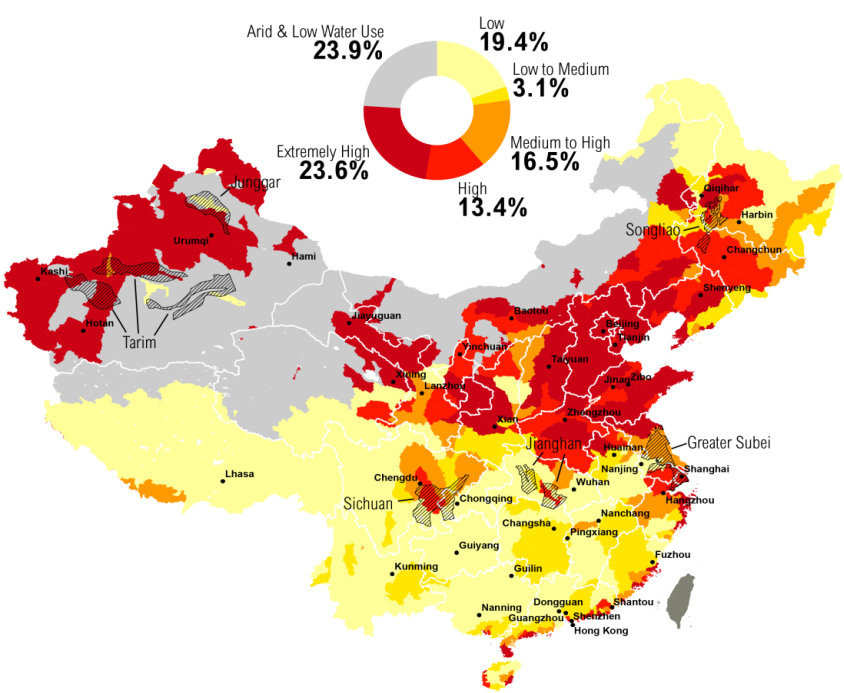
## COAL WASHING

- 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 of 1 bcm by 2020.

# WATER USE IN OIL & GAS SECTOR



CHINA SHALE PLAYS VS **BASELINE WATER STRESS**

## Oil Production

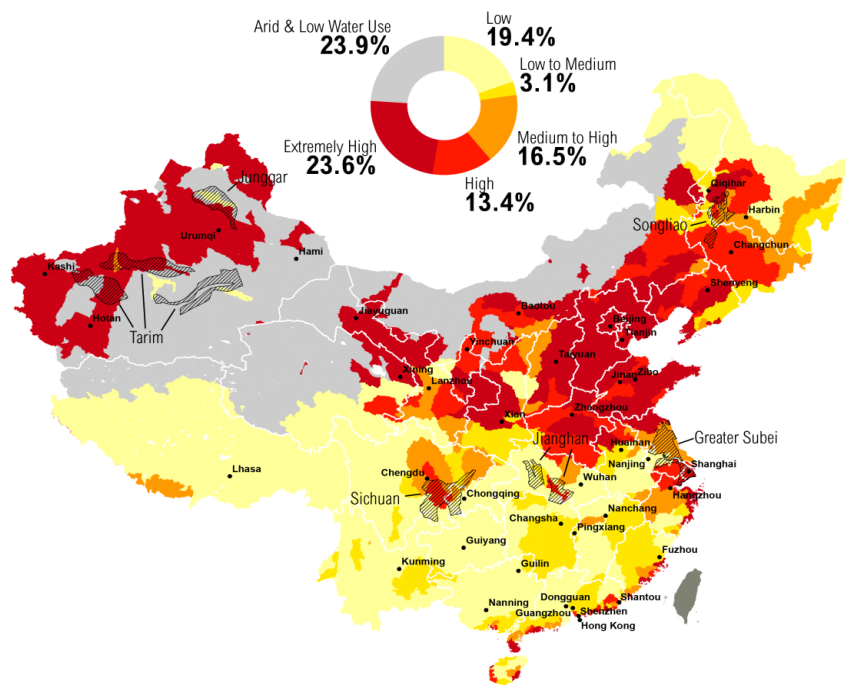
- The water use in conventional oil and gas production is insignificant. It is mainly related to the pressure build up of oil wells and amounts to 0.3 bcm per year.
- However, the oil production also results in highly polluted “produced water”. This can be recycled to pressurizing oil wells.

## 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 aquifers.



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# 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.

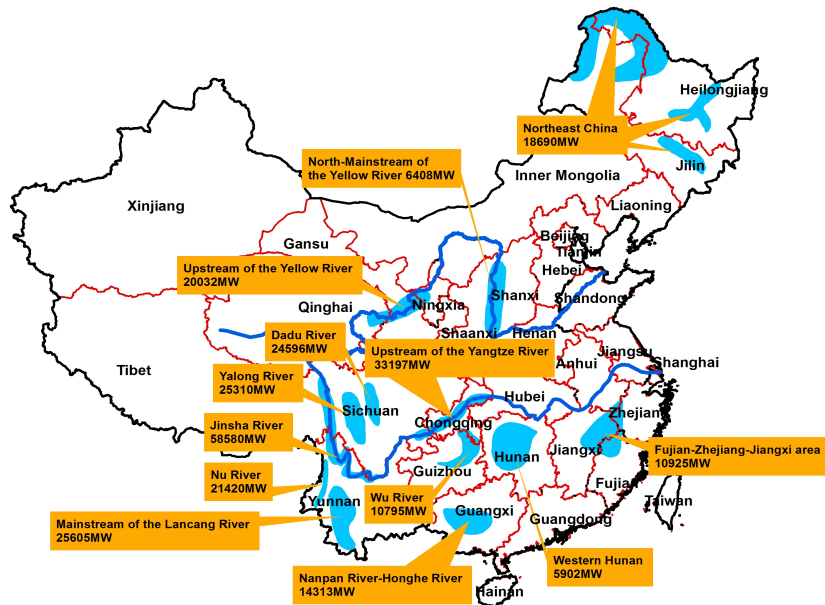
## **Close Loop Cooling**

- 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.

# HYDRO POWER DEVELOPMENT IN PRC

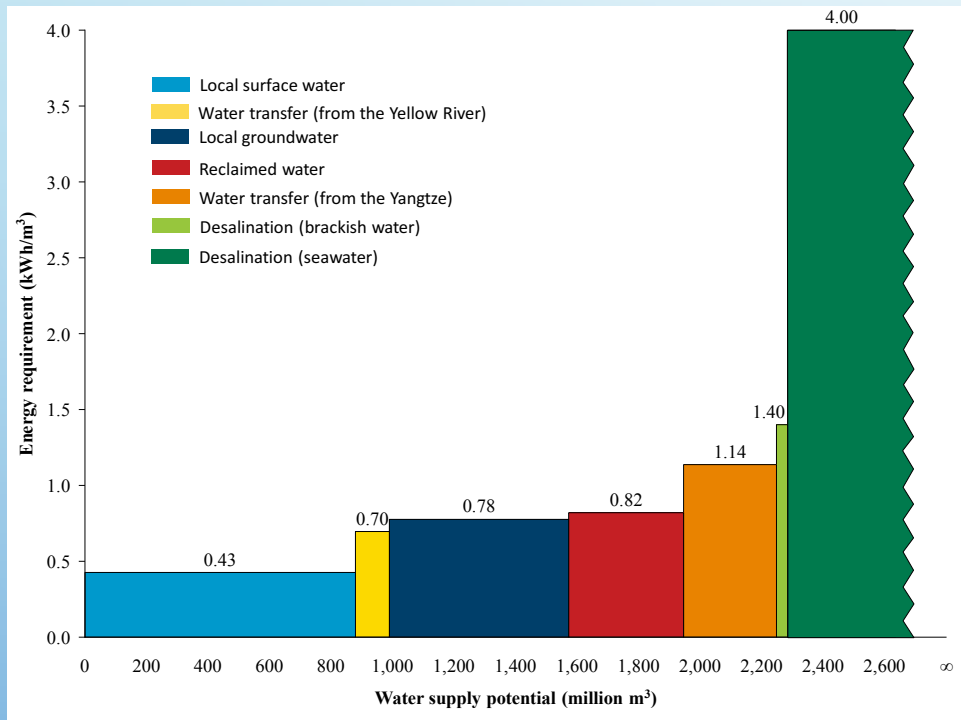


MW = megawatt, PRC = People's Republic of China.  
Source: Ming et al. (2012); Ministry of Water Resources.

- 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.

# ENERGY USE IN WATER SUPPLY

## Electricity Consumption for Different Water Supply Options for Qingdao City



Electricity Consumption related to water supply in PRC is in the range of 4% of total electricity consumption.

Electricity is required for ;

- Ground water extraction
- Long distance water transfer
- Water treatment
- Desalination
- Wastewater treatment

Selection of urban water supply options should take into account the electricity consumption.



# **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
- STRENGTHEN EFFORTS TO DIVERSIFY THE ENERGY SUPPLY FROM COAL
- USE OF MARKET BASED INSTRUMENTS FOR WATER RESOURCE ALLOCATION
- IMPROVED ENERGY EFFICIENCY IN WATER SUPPLY
- IMPROVED DATA COLLECTION OF WATER USE IN ENERGY SECTOR