Water Issues in the Coal Supply Chain in China

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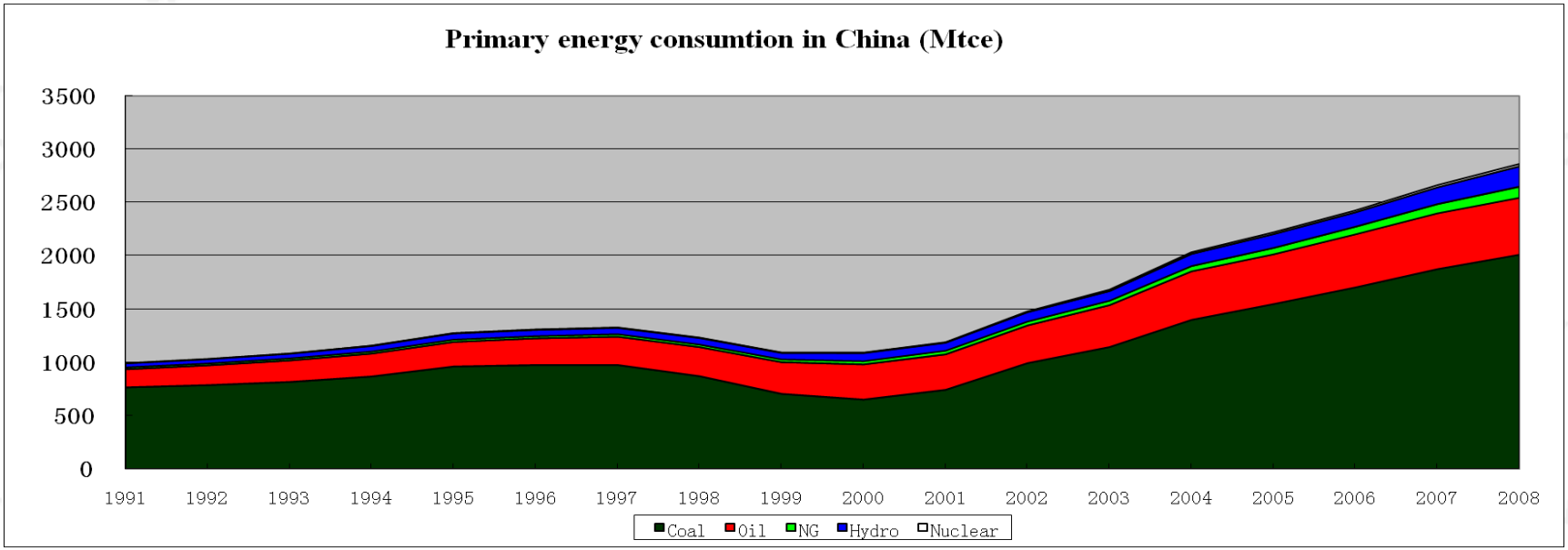
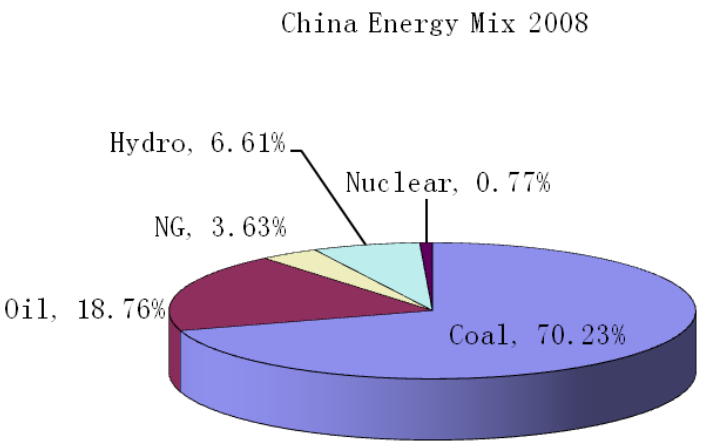
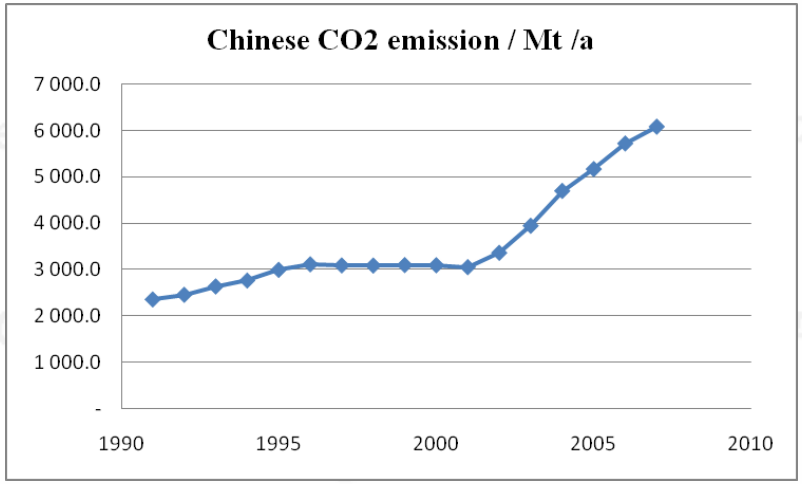
Outline

- Coal and water resources in China
- Existing problems in the coal/water nexus
- Challenges for the future development
- Way out: technical and policy approaches

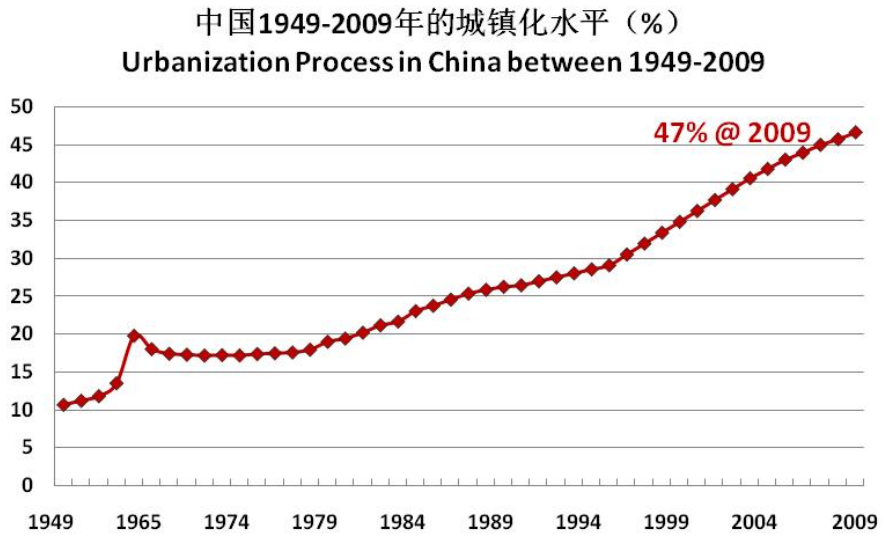
Primary Energy Consumption of China, 1991-2008

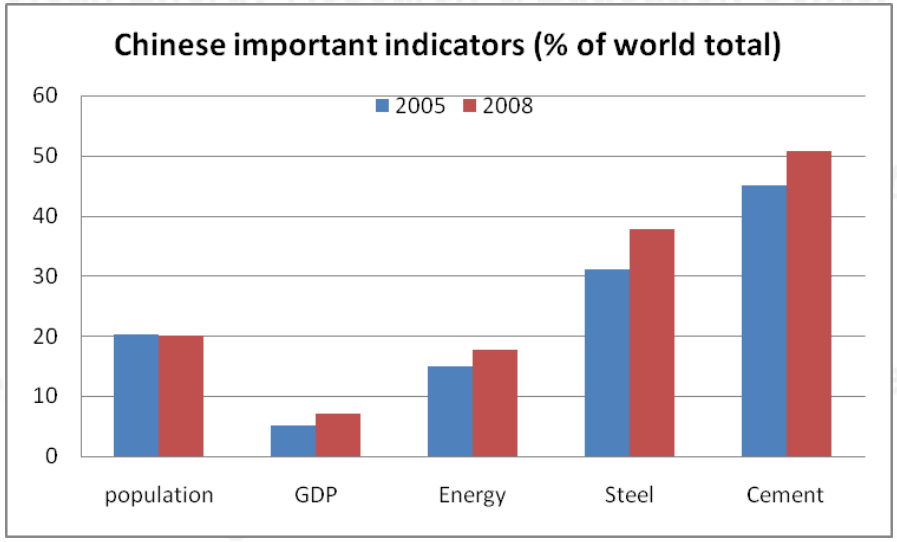


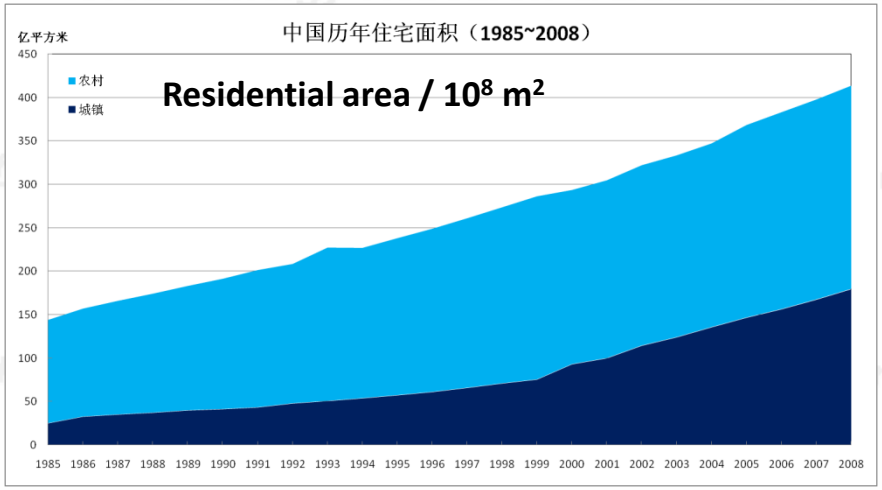


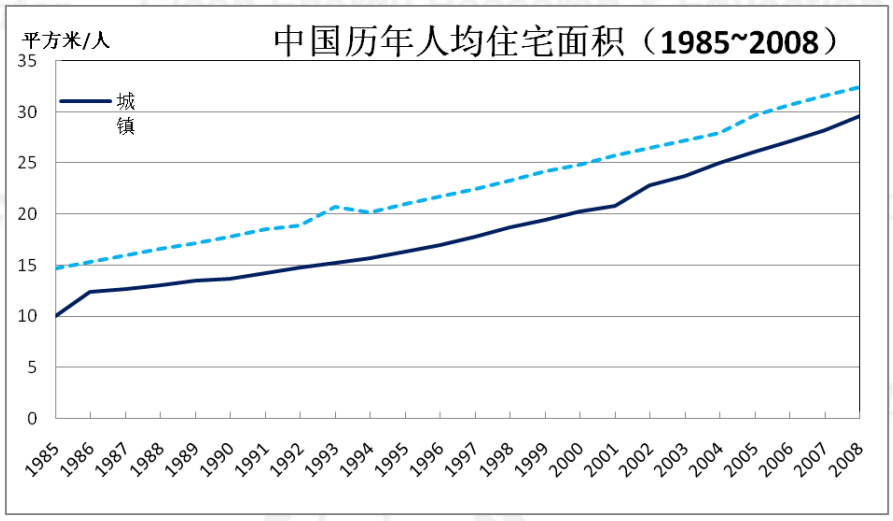


Urbanization Remains a Big Driver for Energy Demand







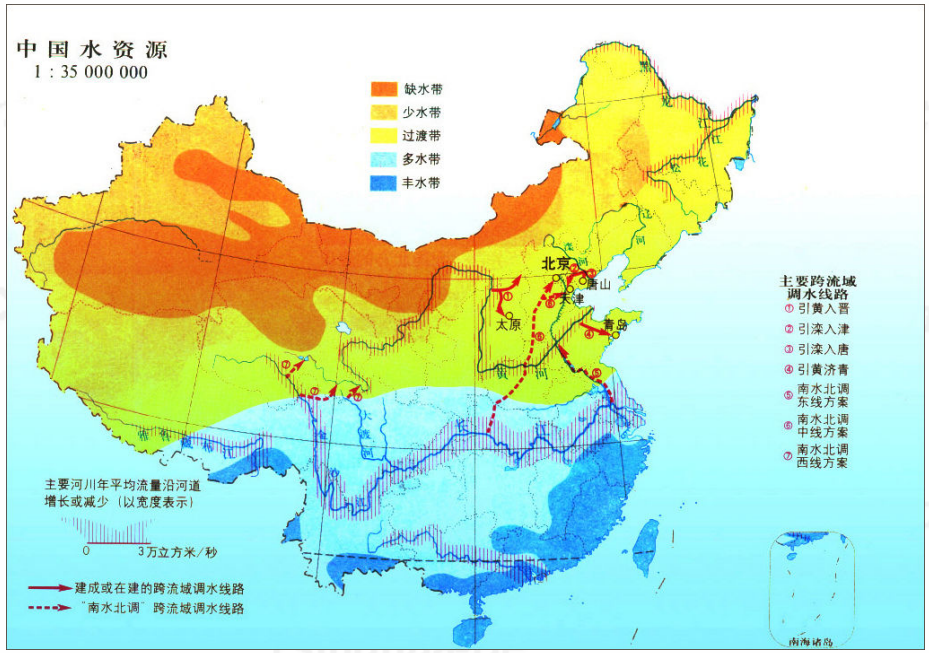


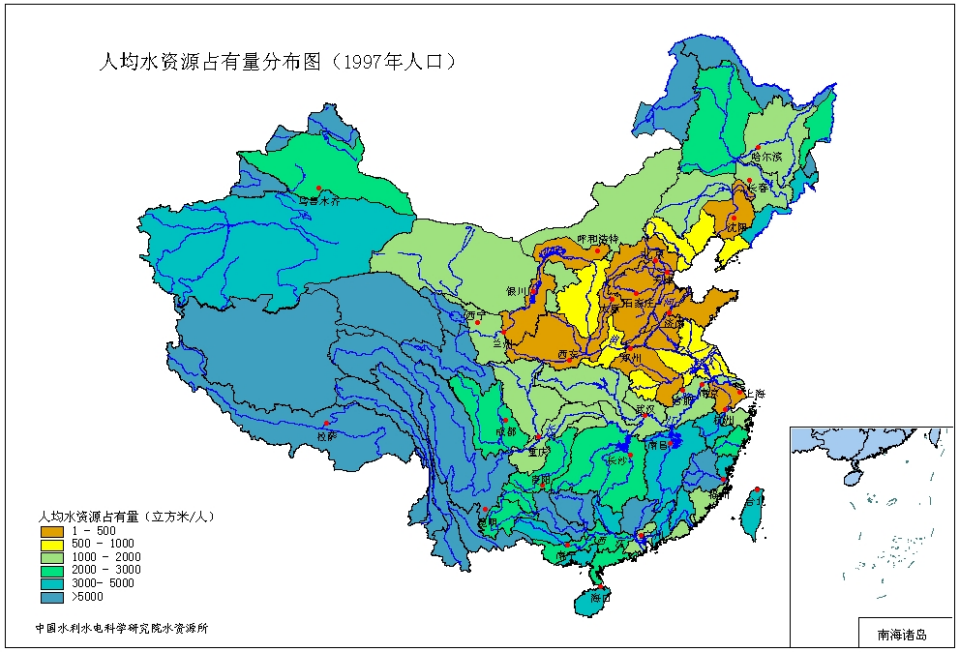
A View of Shanghai in the Future

From Shanghai Urban Planning Exhibition

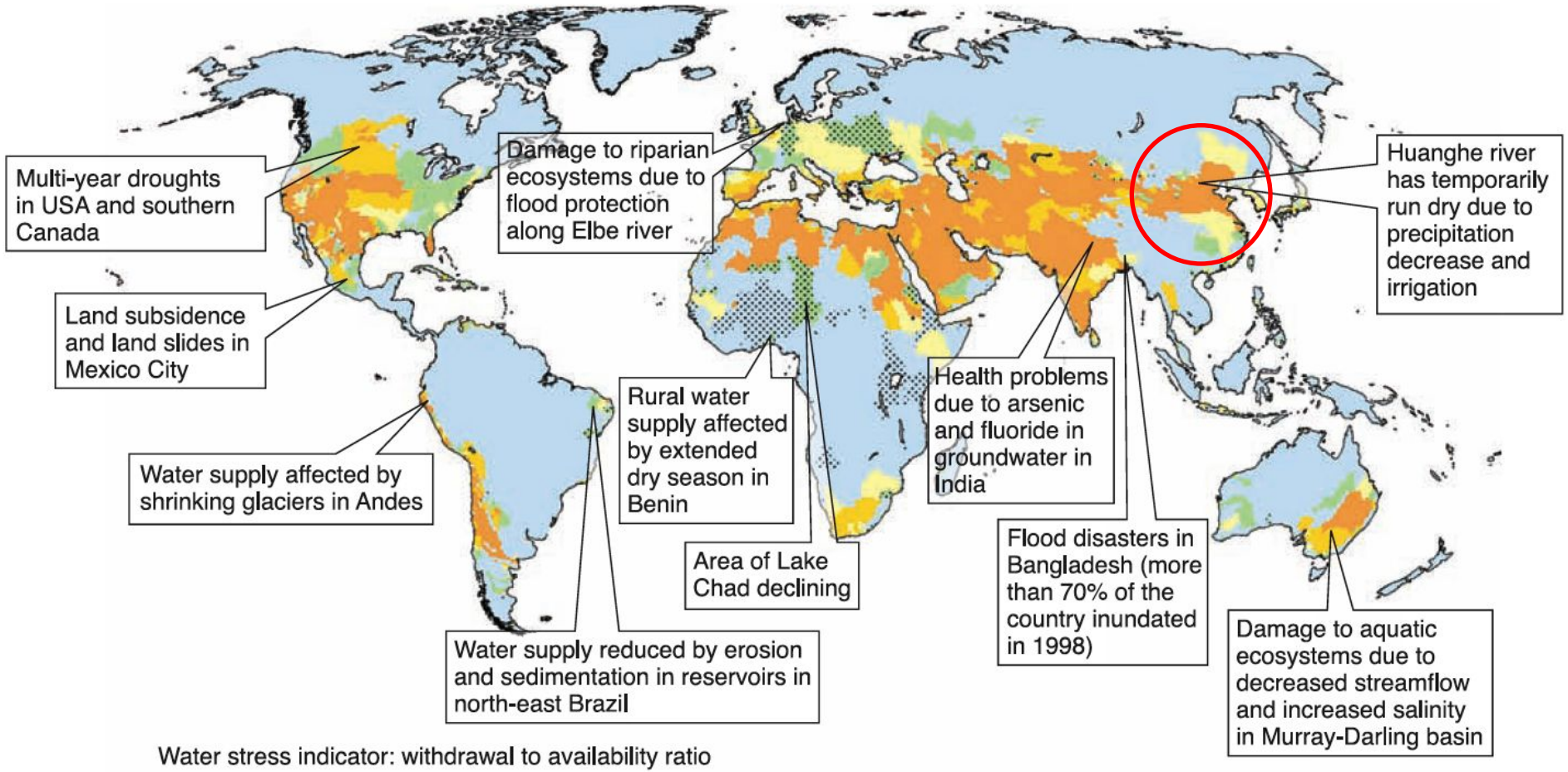
Statistics of Water Resources in China

- Abundant in total, scarce on a per capita basis
  - Total amount in 2008: 2,743bm^3, No.6 in the world after Brazil, Russia, Canada, the United States and Indonesia.
  - 2071m^3 per capita in 2008, 1/16 of Brazilian, 1/10 of Russian, ¼ of world average, ranking after 110, one of the 13 water-scarce countries.
  - Less than 600 m^3 per capita of available water resources, deducting flood and heavily polluted water.
- Abundant in the south, scarce in the north



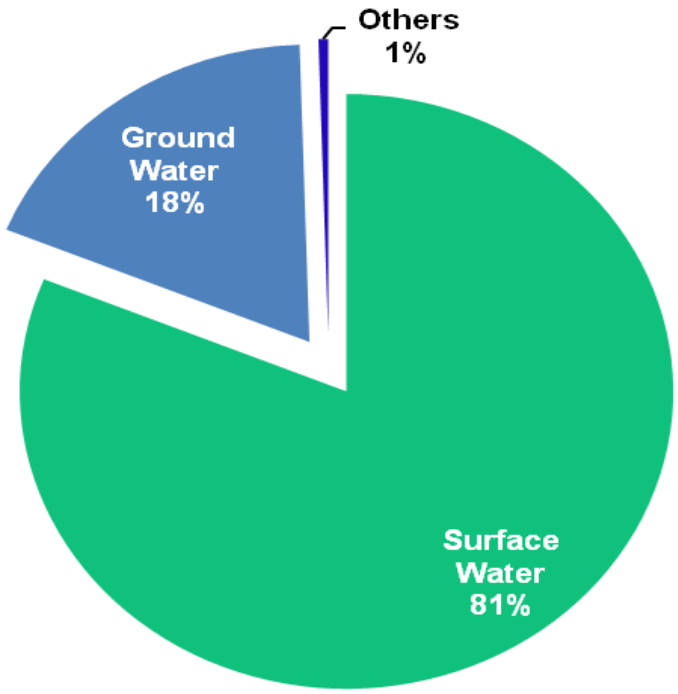


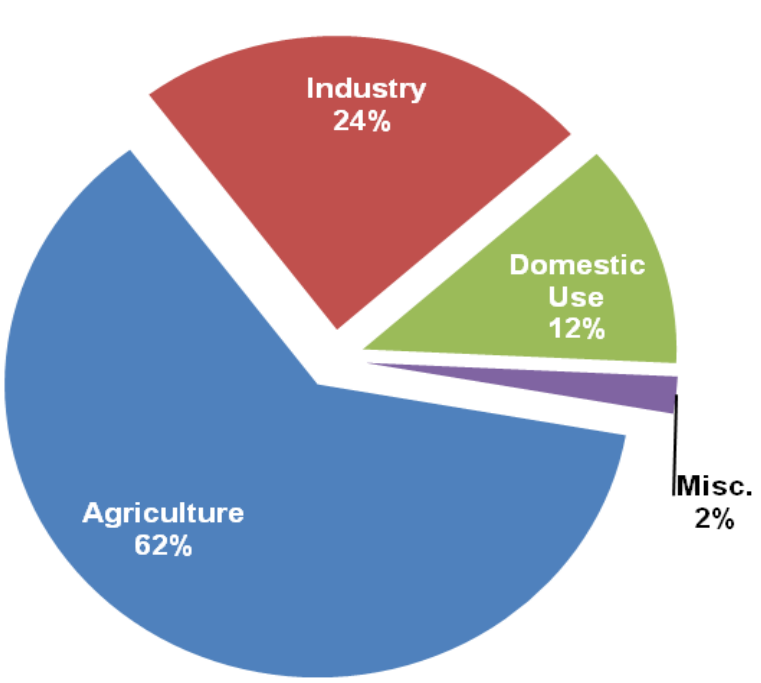
Global and China's Water Stress



Source: Water resources – IPCC WG2, chapter 3

Water Supply and Withdrawal in China



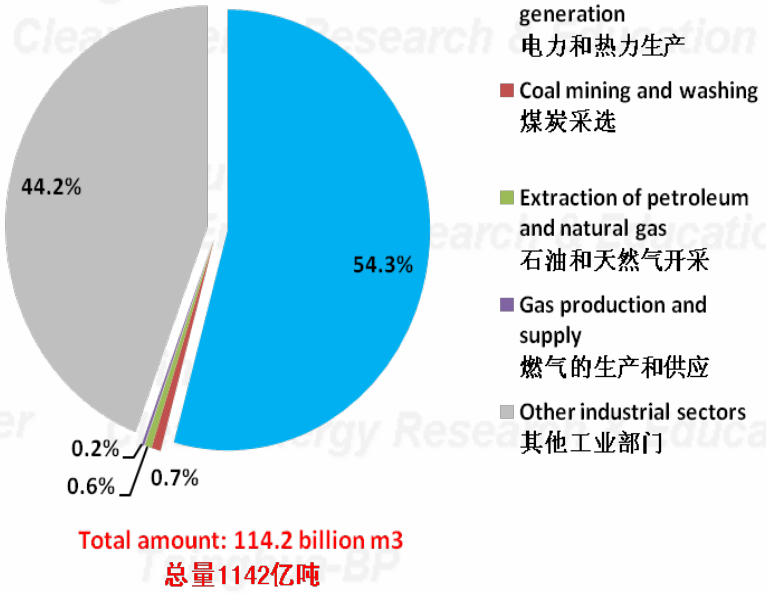


China's total water withdrawal in 2008 was 591 billion cubic meters, and per capita withdrawal was **446** cubic meters, below the global average of **576** cubic meters!

Data source:
China Statistical Yearbook 2009, Beijing, China Statistics Press, 2009; Pacific Institute, *The World's Water 2008-2009*, Washington, D.C., 2008.

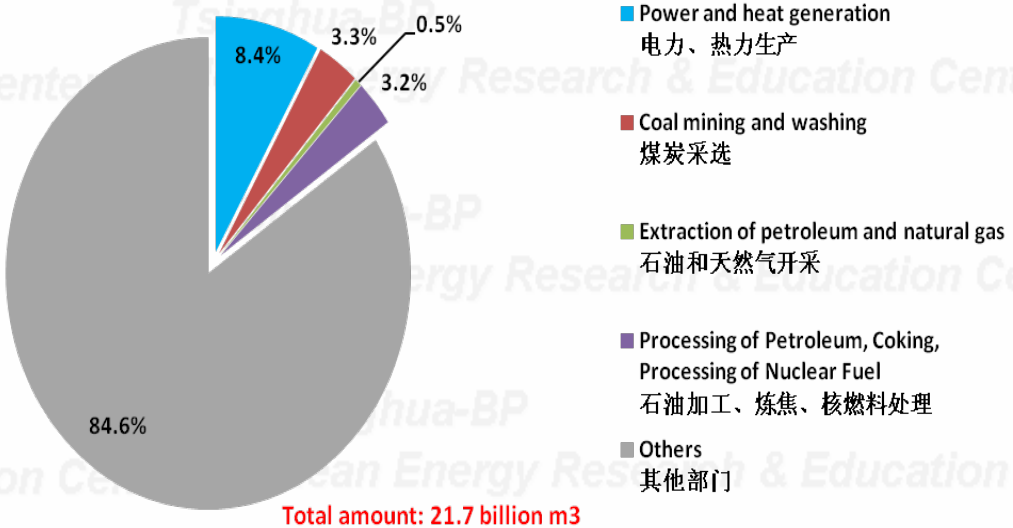
Water Withdrawal and Waste Water Discharge in Energy Related Sectors

Water Withdrawal in Energy Related Industrial Sectors (2002 data)
能源相关部门取水量（2002年数据）



Total amount: 114.2 billion m3
总量1142亿吨

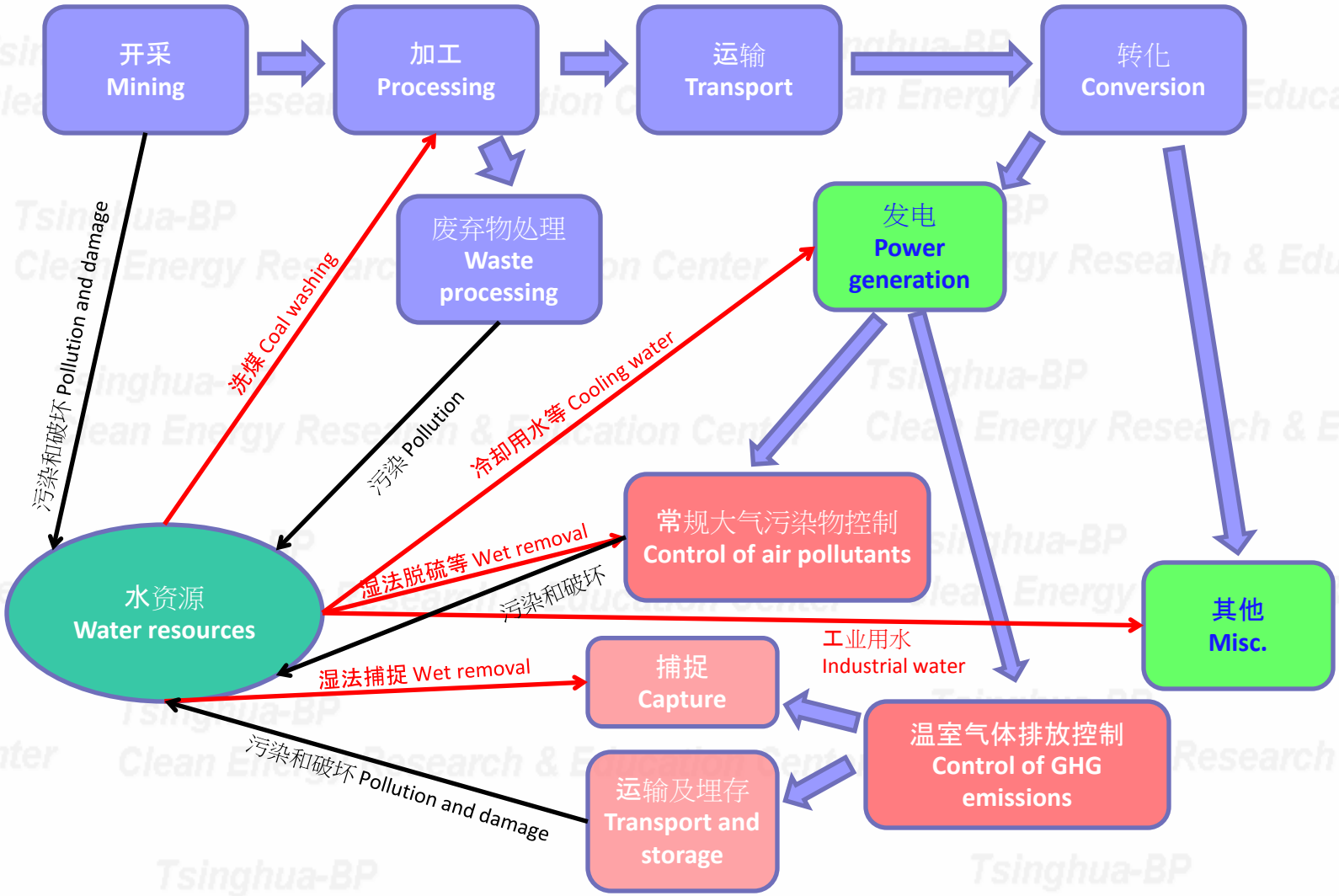
Discharge and Treatment of Waste Water in Energy Related Sectors (2008 data)
能源相关部门工业废水处理排放量 (2008 data)



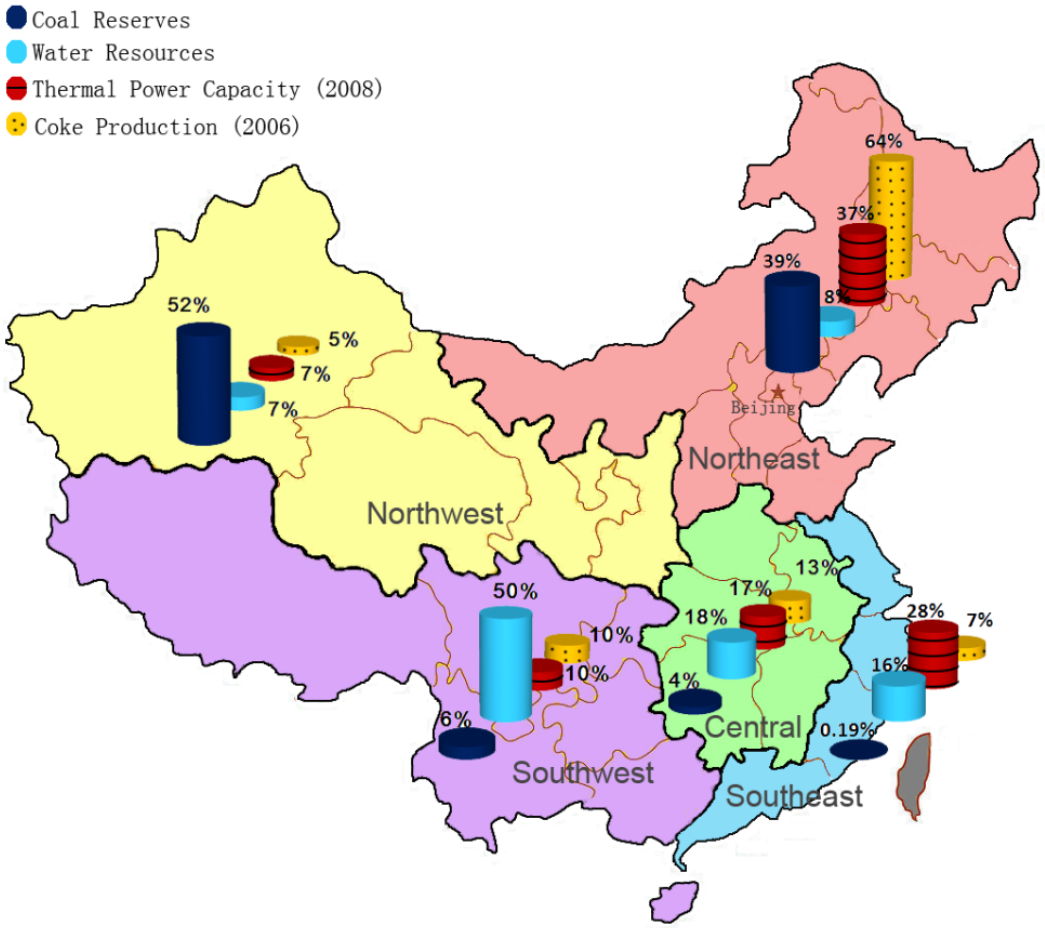
Total amount: 21.7 billion m3
总量217亿吨

Energy sectors are huge consumers of water resources, but not that dirty!

Energy and Water Nexus in Coal Supply Chain



Problem 1
Uneven Distribution of Water, Coal, and Energy Demand



Coal Reserves, water resources and coal industry distribution in China

Problem 2
Inefficient Utilization of Water Resources in Coal Mining

- China has approximately 15,000 coal mines with the total productivity of 3.69 billion tonnes
  - **70 percent** of China's coal mines are located in **water-scare regions**
  - **40 percent** of them have severe problems of **water shortage**
- Environmental impacts caused by water withdrawal and drainage in coal mining
  - Damage to underground water:

    1.07 m^3/t (Shanxi average)
  - Groundwater level descending
  - Soil salinization
  - Land desertification

Problem 2 (Continued)
Inefficient Utilization of Water Resources in Coal Mining

- Pollution
  - Waste water drainage: **~4 m^3/t**
  - Coal gangue and other solid waste: 4.5 billion tons, occupying 15000 hectares lands (2009 data)
- Water Recycling
  - Current recycle rate of coal mine water: **22%**

Problem 3
Extensive Water Consumption in the Coal Power Sector

Industrial cooling loss 3%

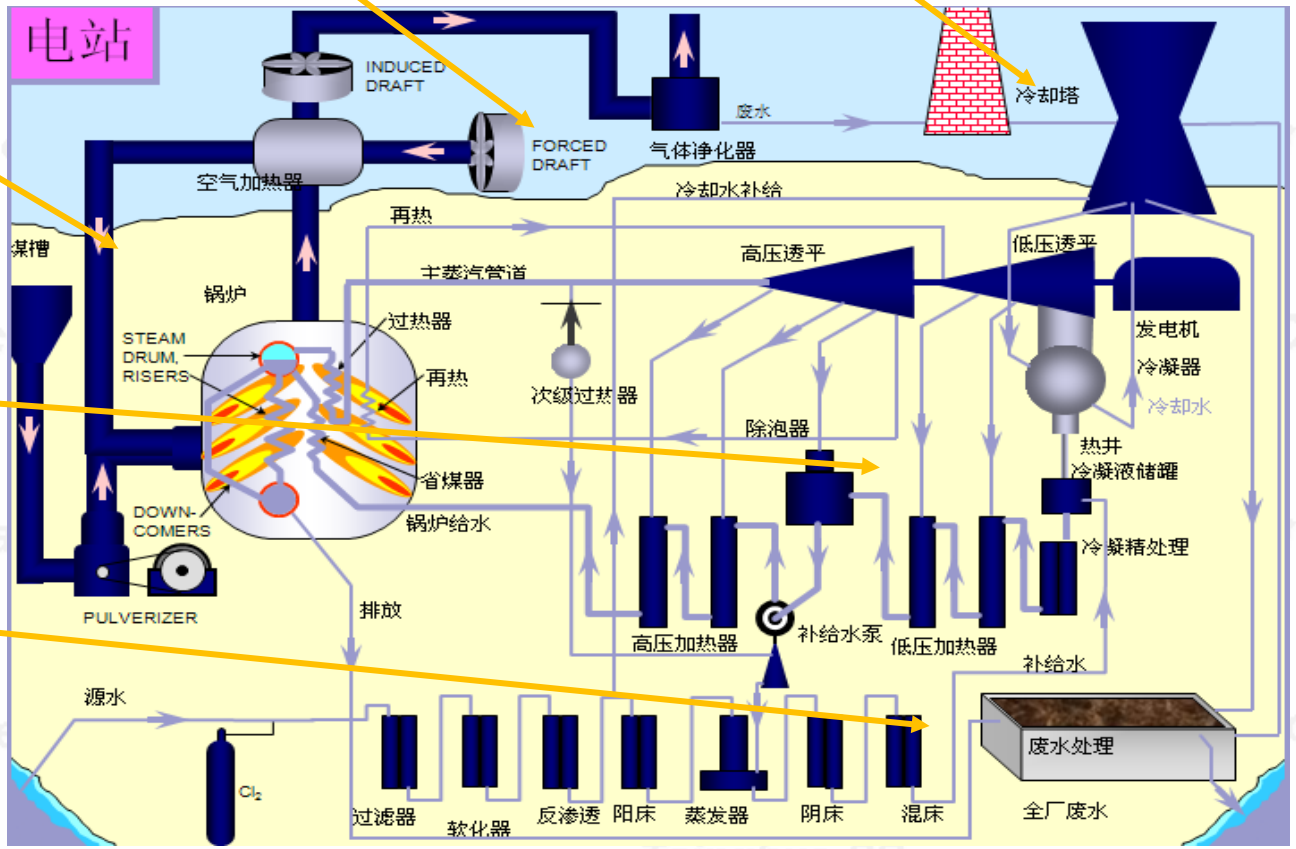
Ash removing 10-45%

Cooling tower 40%-50%

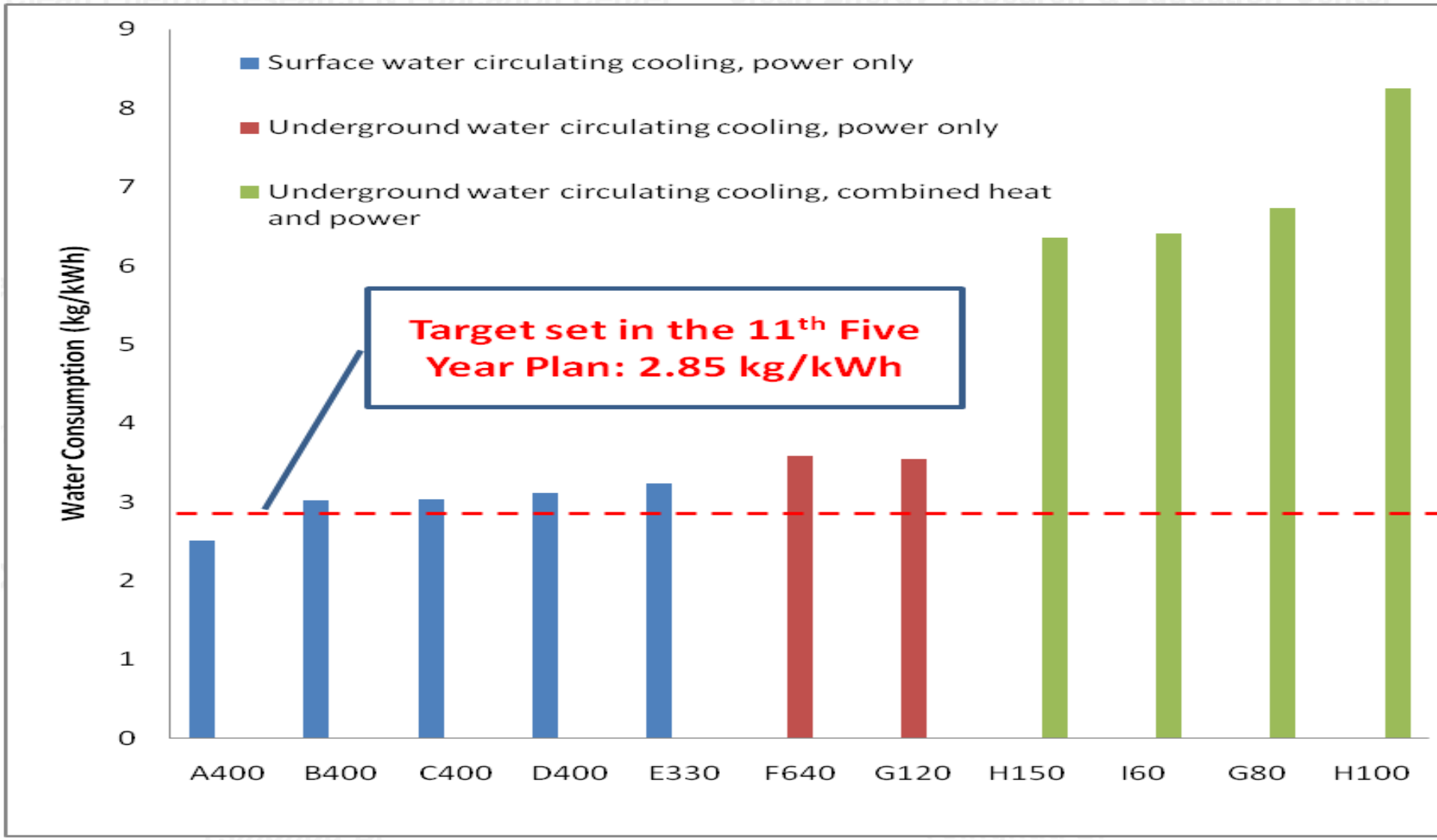
Steam loss 2-4% of the boiler evaporation

Water treatment 1%-3%

Staff living water emergency use loss 2-4%



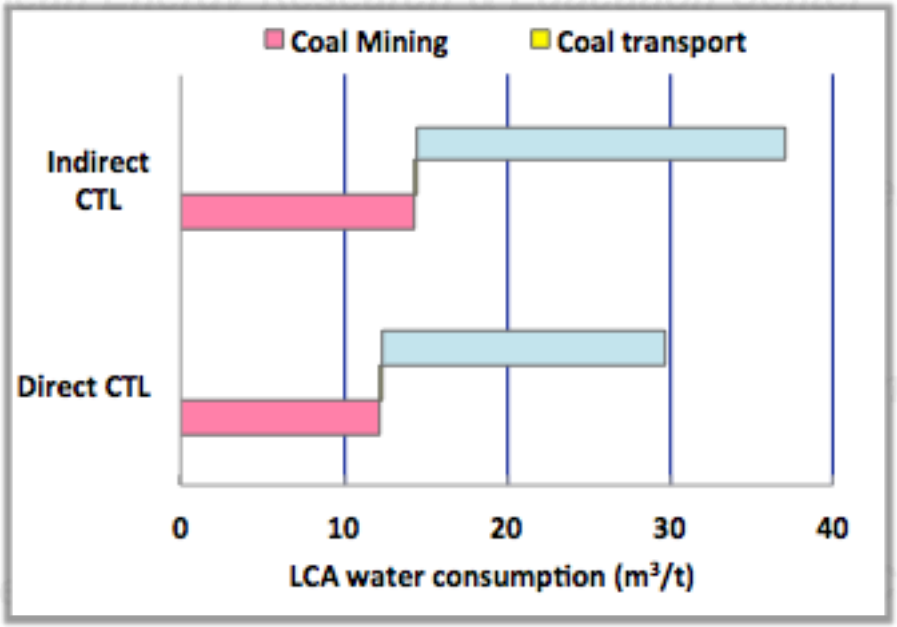
Problem 3 (Continued)
Extensive Water Consumption in the Coal Power Sector



Problem 4

Expected Increase in Water Consumption in the Future

1. Increasing demand for energy
2. Possible boost of coal-to-liquids or coal-to-chemicals industry due to increasing dependence on oil import and lack of security
3. Possible requirements for coal power plants to install CO_2 capture utilities, which would double the water consumption of a power plant



Constraint for Future Development

- In November 2010, the State Council announced the strictest ever policy about water resources management, according to which the industrial water consumption will drop in 2020 and 2030 compared with 2008 level.

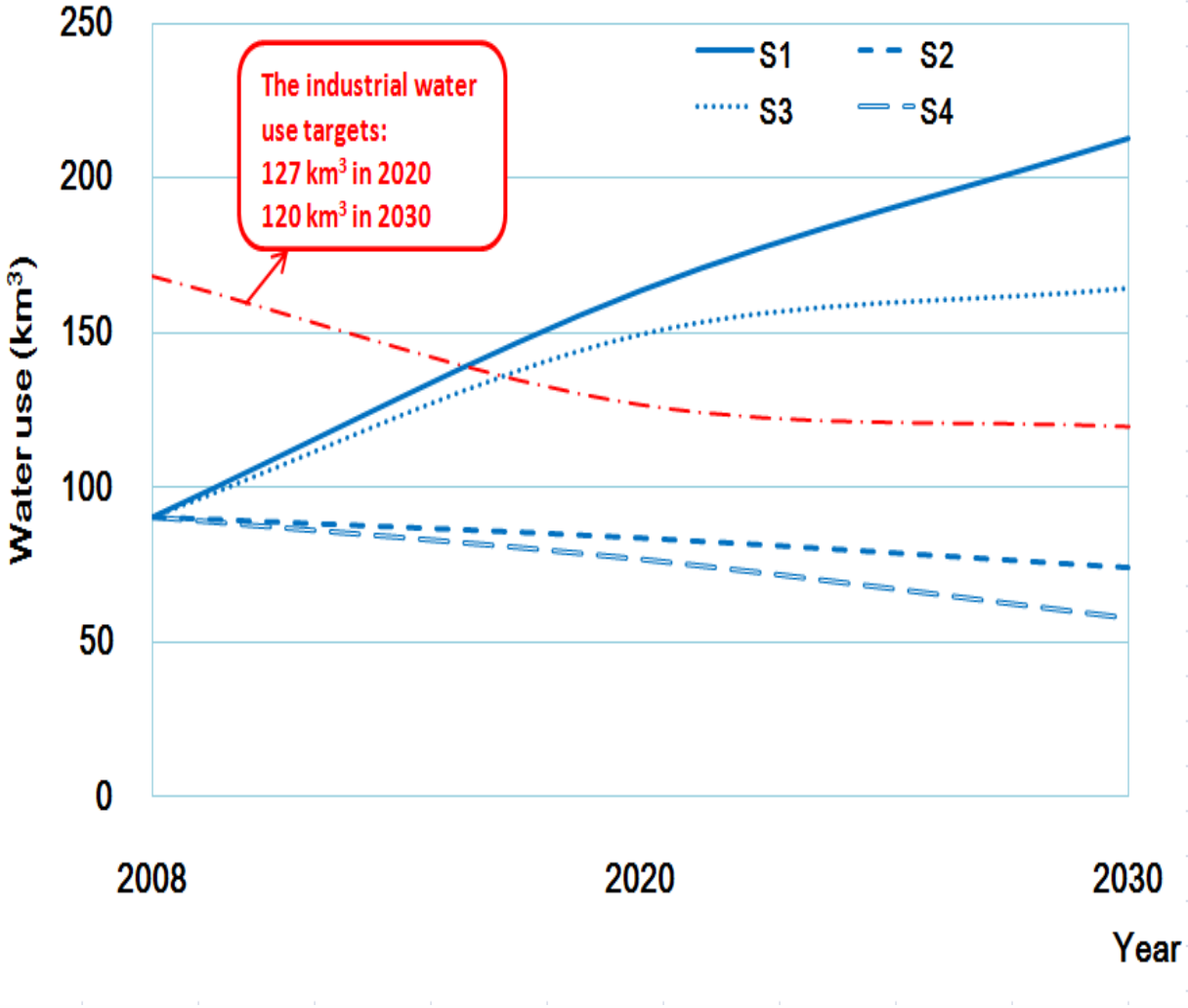
- Considering fast development of the coal industry China, demand for water by the coal sector will also increase in a business-as-usual scenario.

State Council Plan for water consumption in 2020/2030

Year	GDP (¥ billion)	IAV (¥ billion)	IAV/GDP (%)	Water use for ¥ 10,000 GDP[1] (m^3)	Water use for ¥ 10,000 IAV[2] (m^3)	TWU[3] (km^3)	IWU[4] (km^3)
2008	30,067	12,911	42.9	231.8	130.3	584	168
2020	55,833	19,542	35.0	120	65	670	127
2030	100,000	30,000	30.0	70	40	700	120

[1] GDP: gross domestic production
[2] IAV: industrial added value
[3] TWU: total water use
[4] IWU: industrial water use

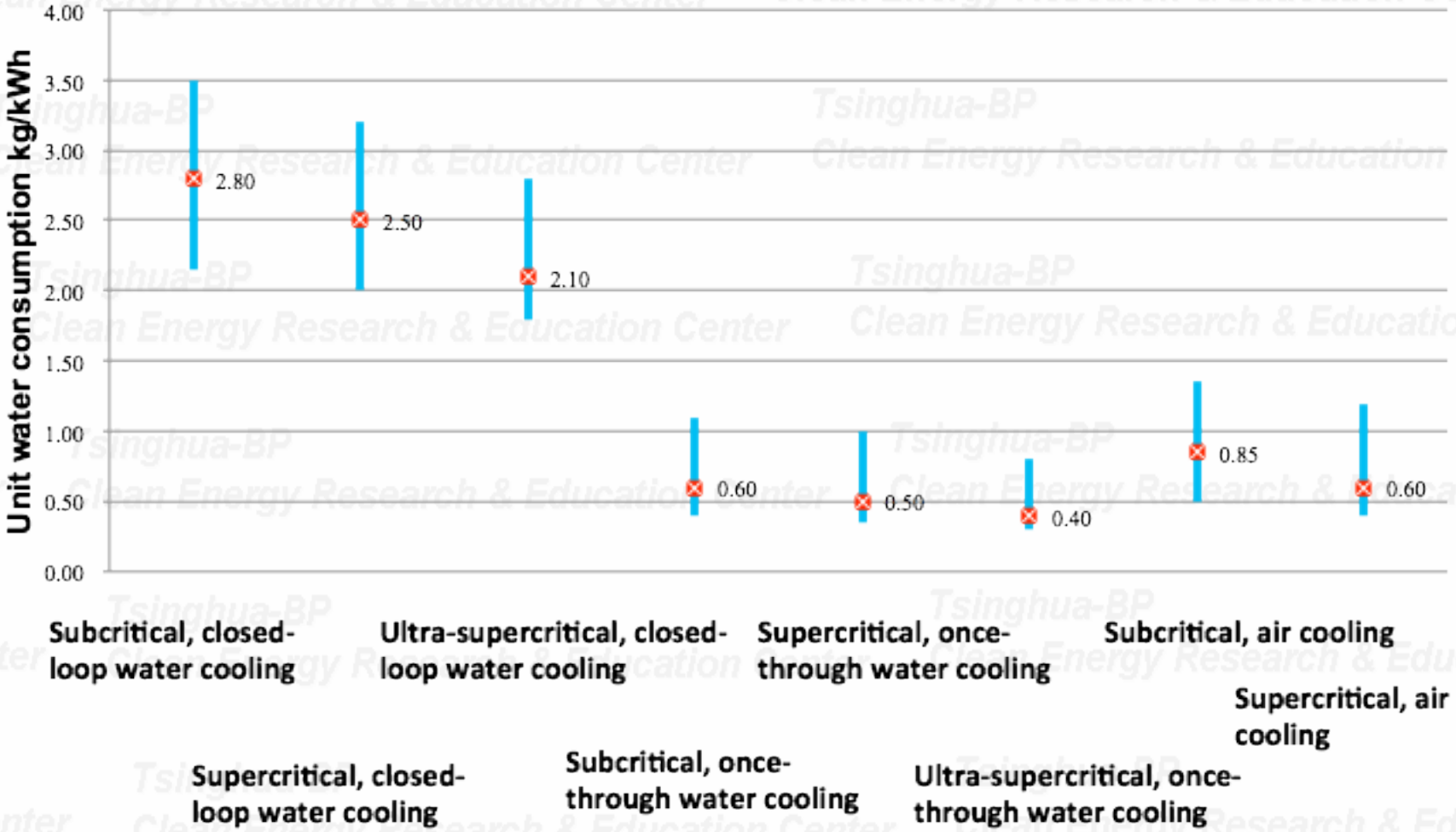
Scenario Analysis on the Industrial Water Use



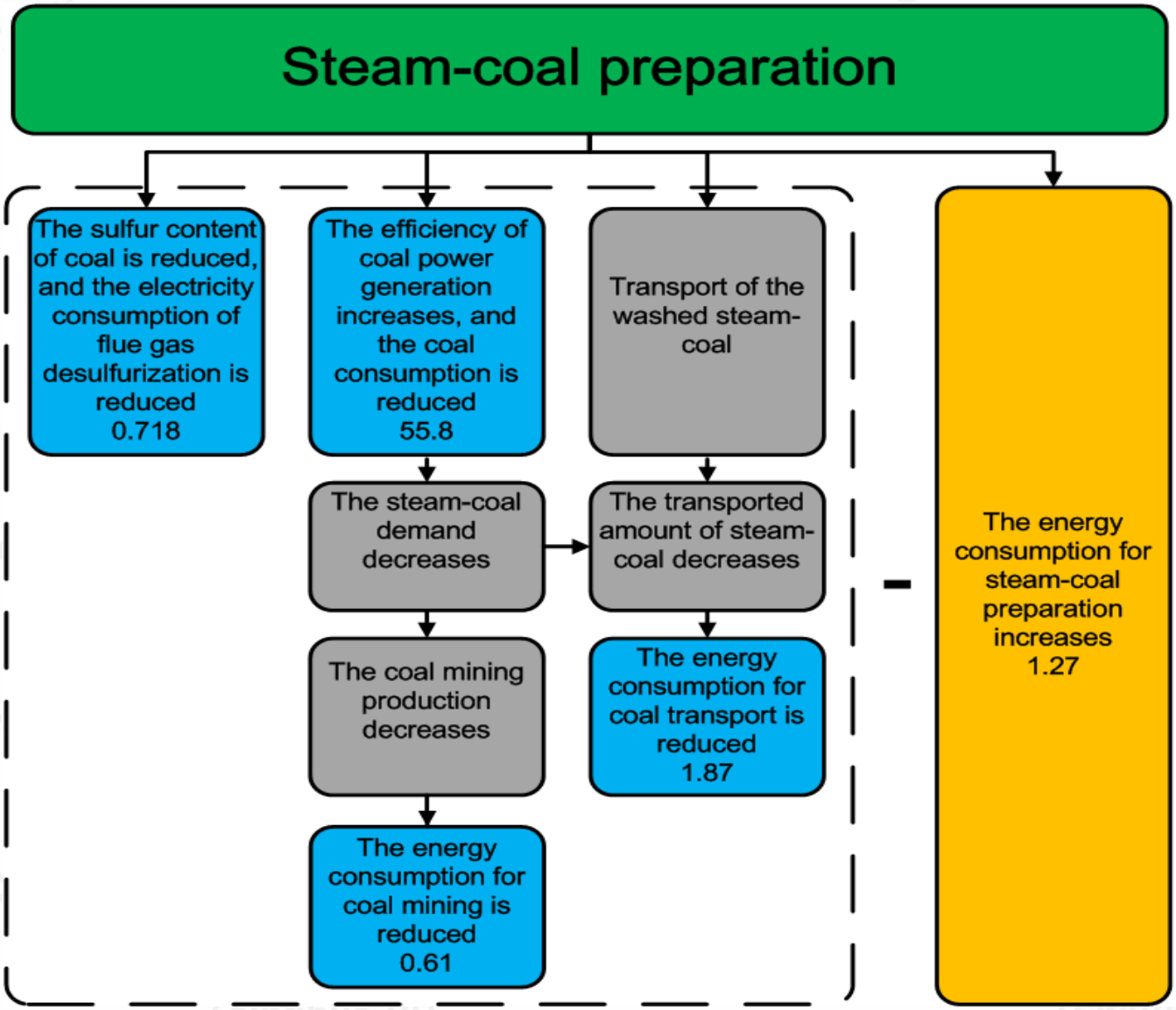
Industrial water use in four scenarios by 2020 and 2030

- Scenario 1 (S1) serves as a BAU mode, taking no consideration of policies changes and technology improvement
- Scenario 2 (S2) considers impacts of technology improvement
- Scenario 3 (S3) considers impacts of policies changes
- Scenario 4 (S4) considers both technology improvement and policy changes

Technical Means - An Instance: Air Cooling

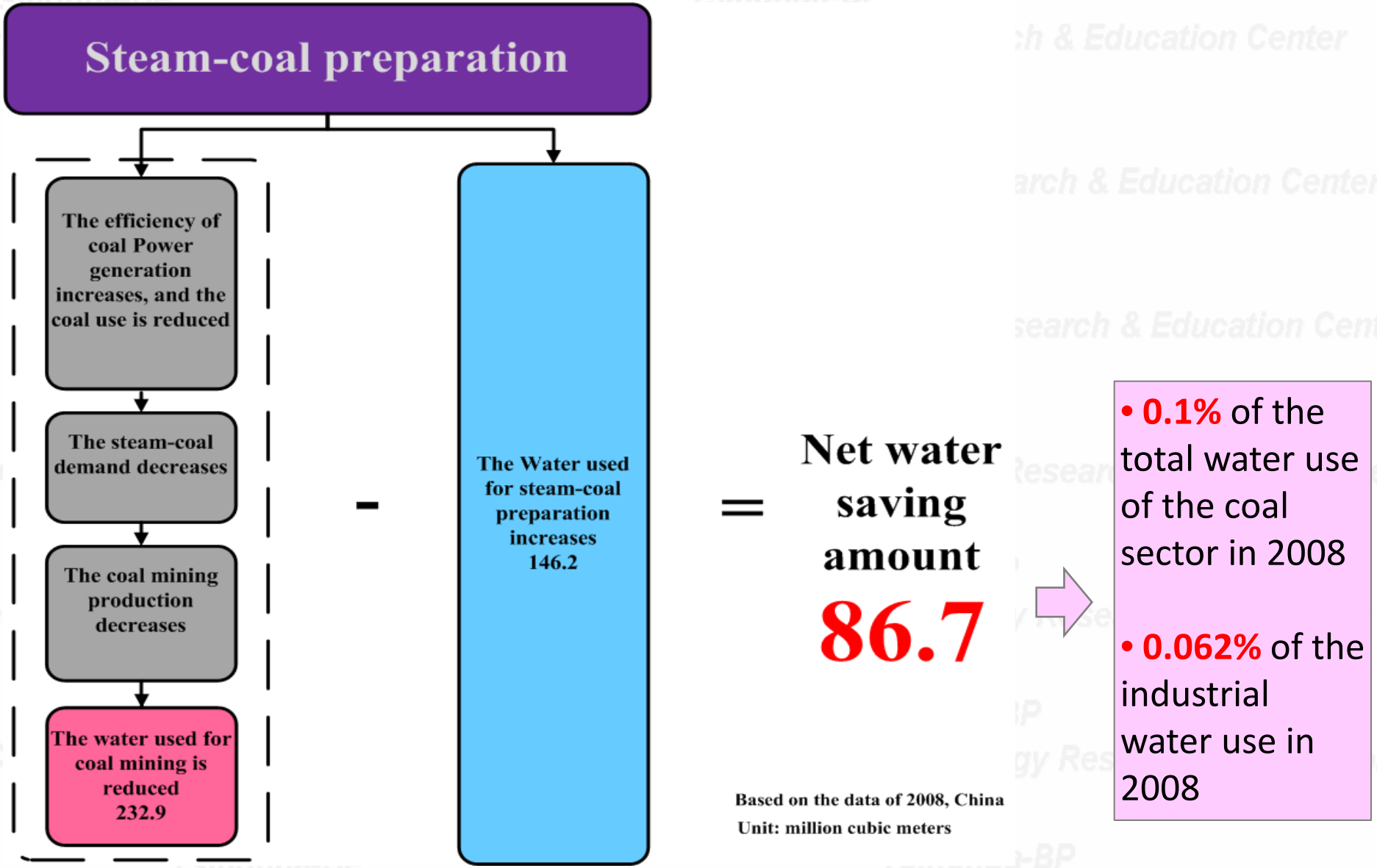


Technical Means - An Instance: Coal Washing



The net energy saving amount equals to 8.2% of the total energy consumption of the coal supply chain in 2008

Technical Means - An Instance: Coal Washing



- **0.1%** of the total water use of the coal sector in 2008
- **0.062%** of the industrial water use in 2008

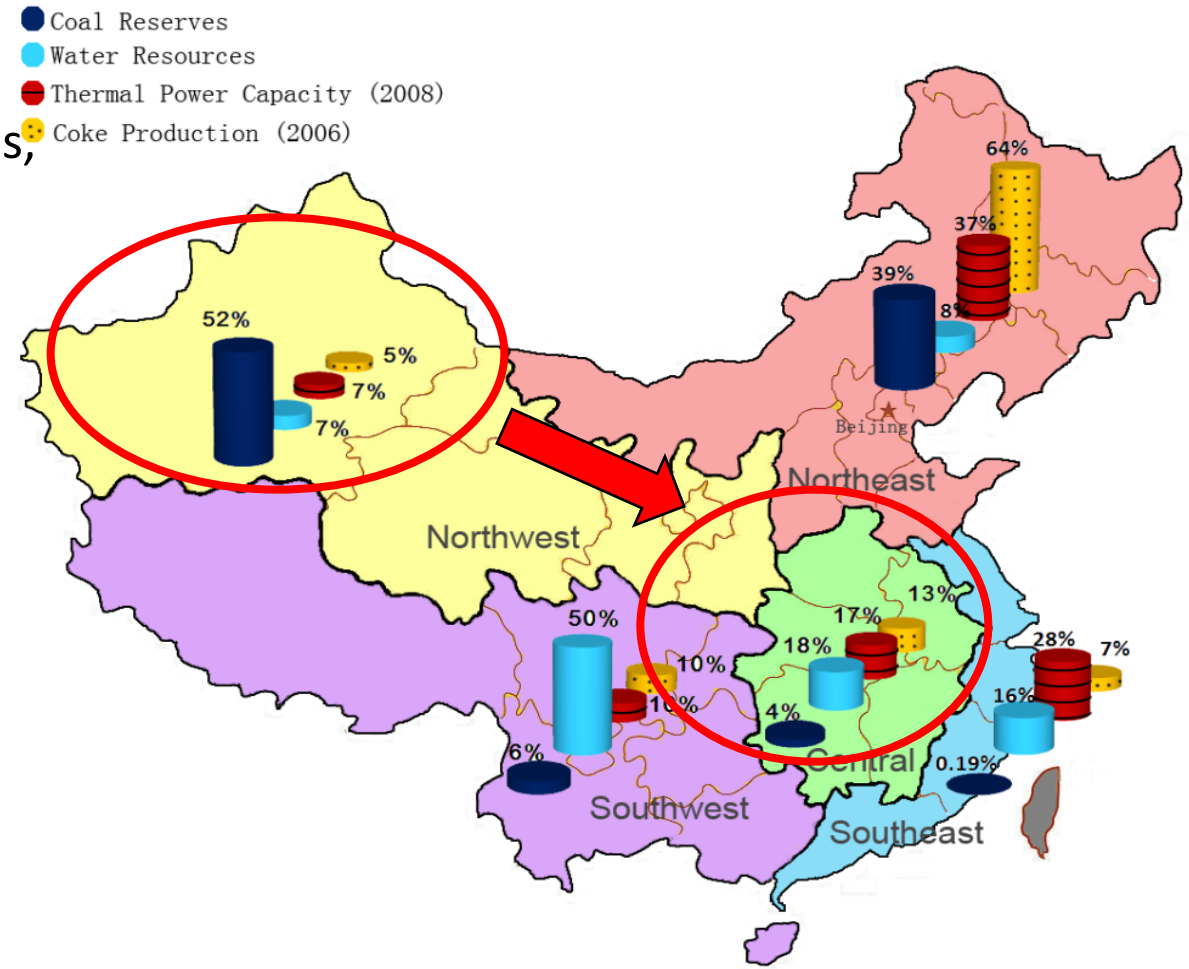
Policy Means: Systematic Design and Planning

- **What?**
- Coal, electricity, chemicals, SNG, …

- **Where?**
- Location of coal mines, conversion plants

- **How?**
- Railway, road, pipeline, …

- **When?**
- Timing of expansion



Conclusions

- Water issues are neither global nor national, but regional ones
- Mismatch of coal reserves, water resources, and energy demand is the top challenge
- Less-advanced and inefficient utilization of water resources exist in most parts of the coal supply chain in China
- Severe constraint on water consumption for industrial sectors is foreseeable in the near-term futures
- A BAU mode cannot meet the target on water consumption, technical and policy changes are the way out