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The energy-water nexus for integrated resource policies – a case study of China

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Ying Qin, Elizabeth Curmi, Grant Kopec,
Julian Allwood, Keith Richards

bp

UNIVERSITY OF CAMBRIDGE

Introduction

Energy

Water

Energy and water policies are usually developed in insolation from each other.

Is there a mismatch between the individual plans for energy and water in China?

Coal and water in China

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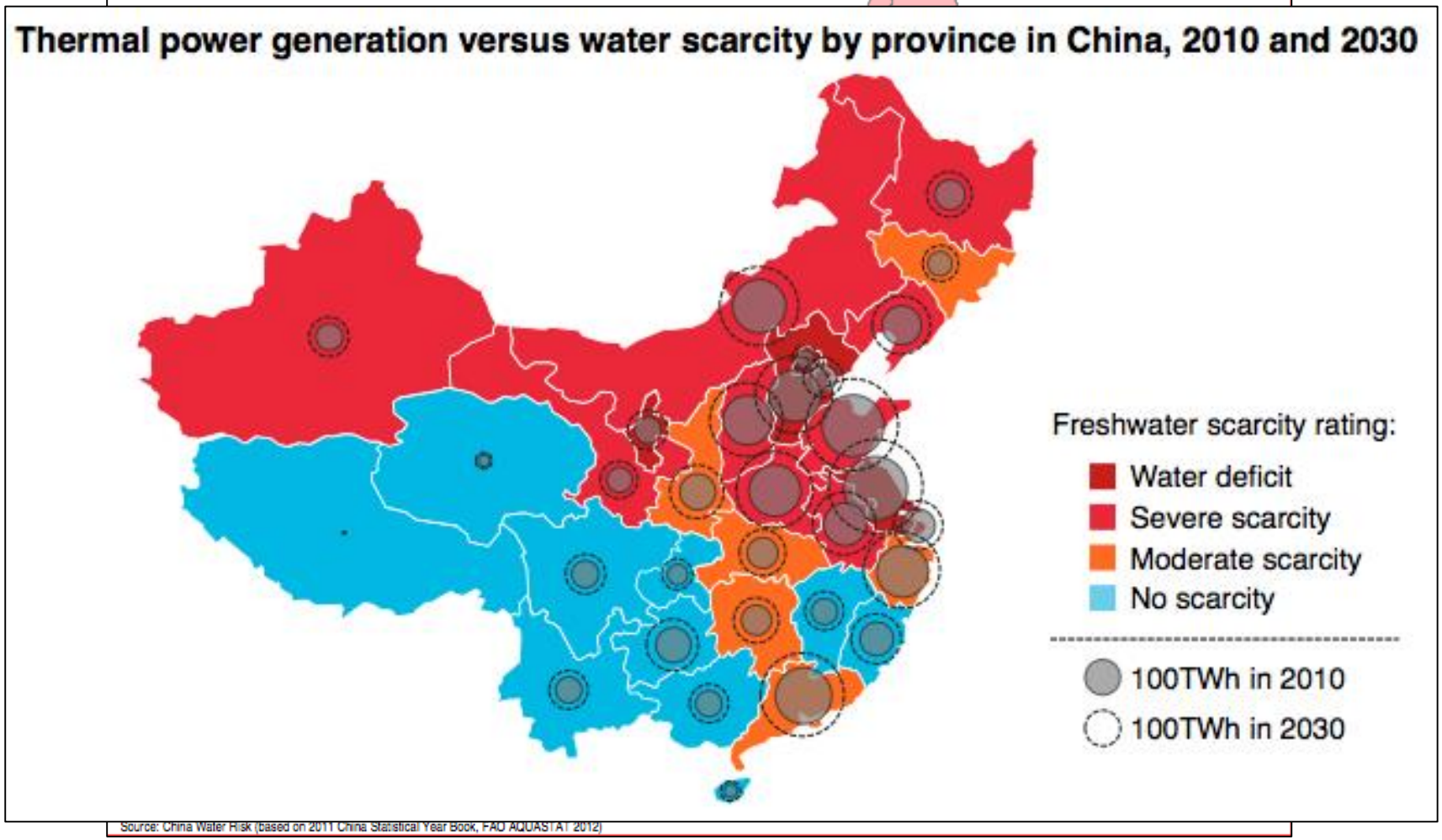
Map 2: Location of China's ensured coal reserves in 2010



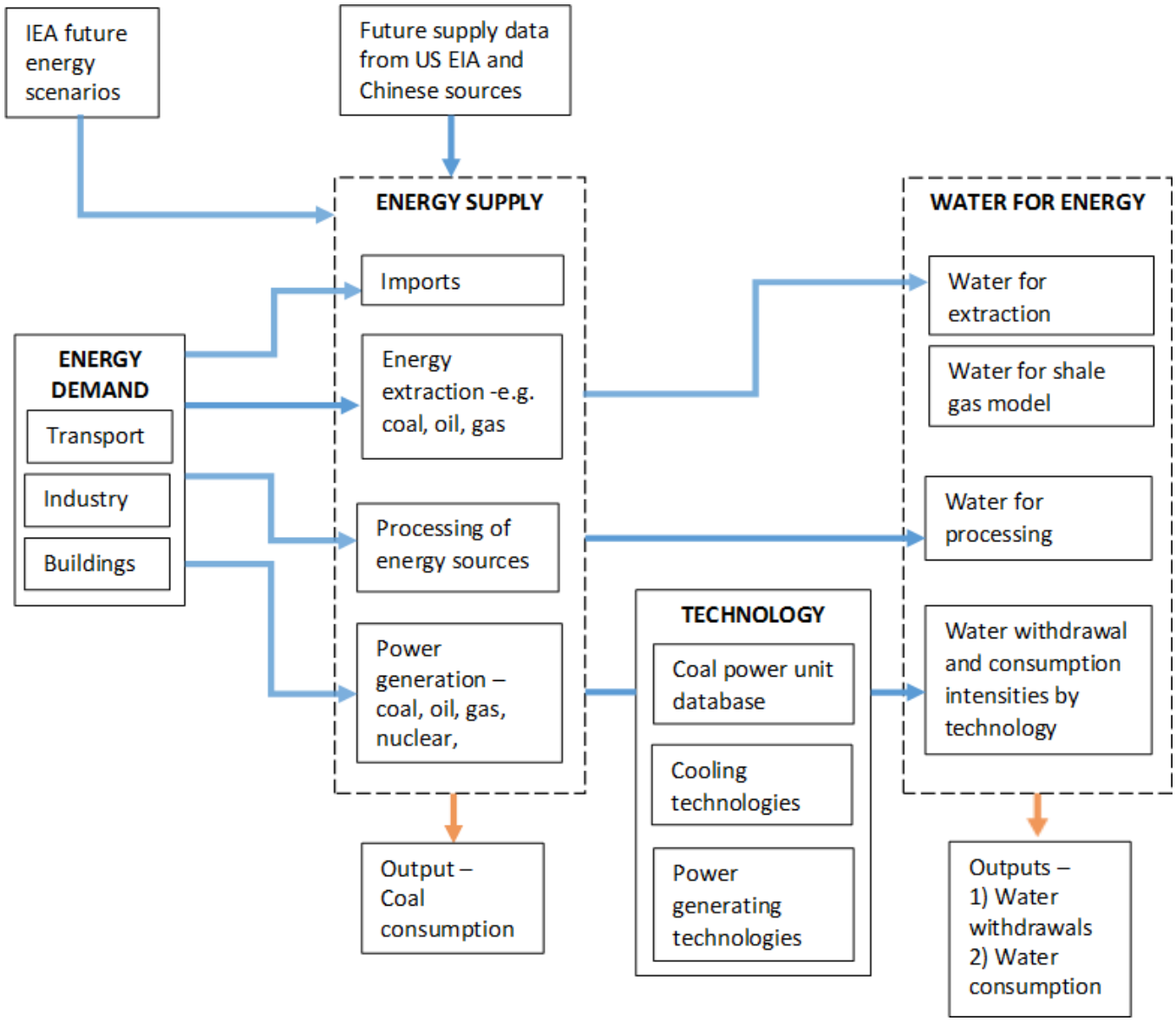
Source: China Water Risk (based on 2011 China Statistical Year Book, FAO AQUASTAT 2012)

“3 red lines” water policies

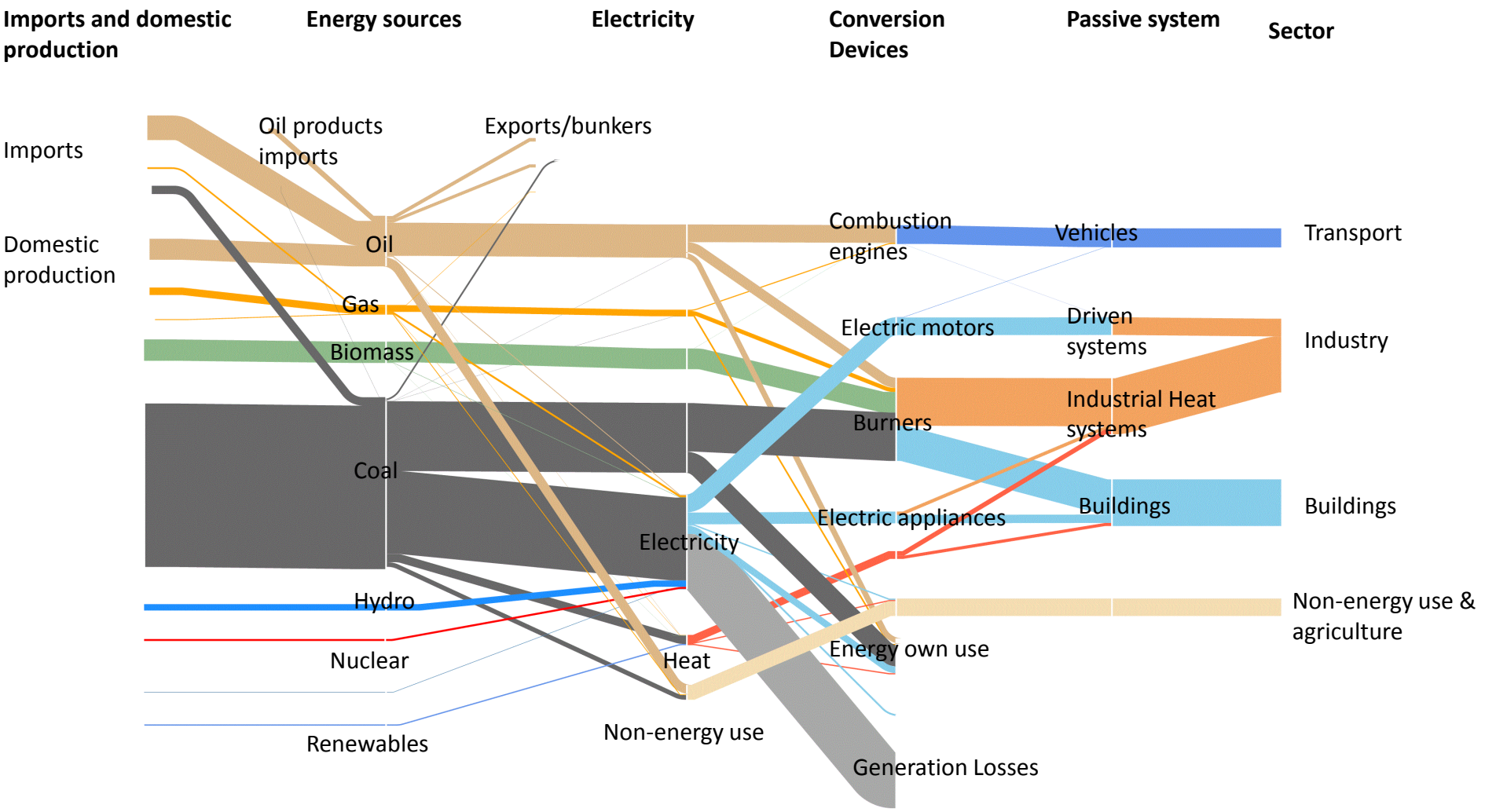
- **National Cap**
  - Cap national water demand at 635 bcm (billion m^3) by 2015, 670 bcm by 2020 and 700 bcm by 2030.
- **Efficiency**
  - Reduce water usage per 10,000 RMB of IVA (IVA is the contribution of industry to the overall GDP) from current 130 m^3 to 65 m^3 & 40 m^3 in 2020 and 2030 respectively.
  - Improve water irrigation efficiency to above 53% by 2015, 55% by 2020 & 60% by 2030.
- **Quality**
  - 60% of water systems (rivers & lakes) to meet national water quality standards by 2015, this increases to 80% and 95% by 2020 and 2030 respectively.

Each province has their own set target.

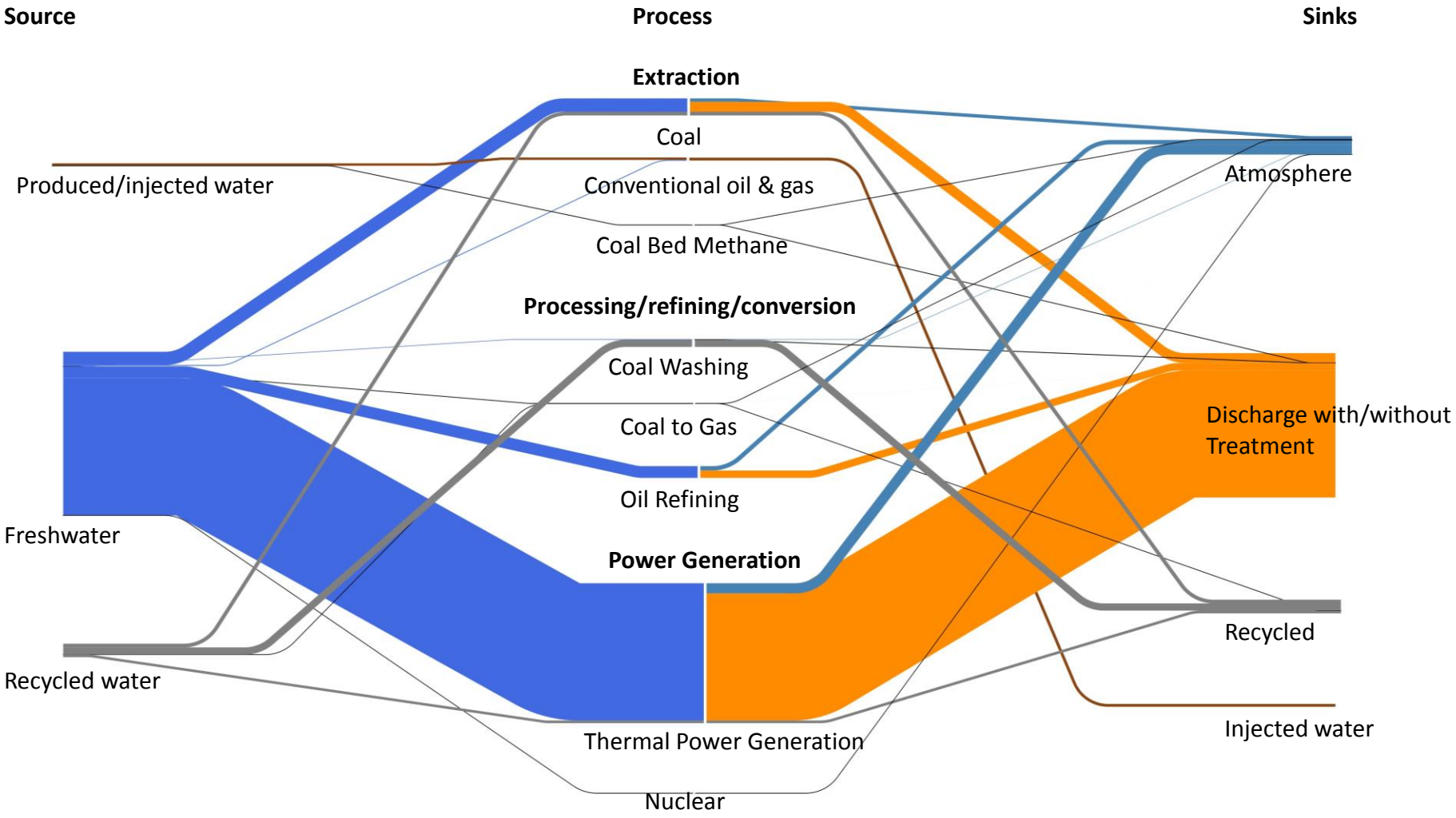
Energy and water study in China- methodology



2010 Energy in China



2010 water used for the energy sector in China



Demonstration of Foreseer

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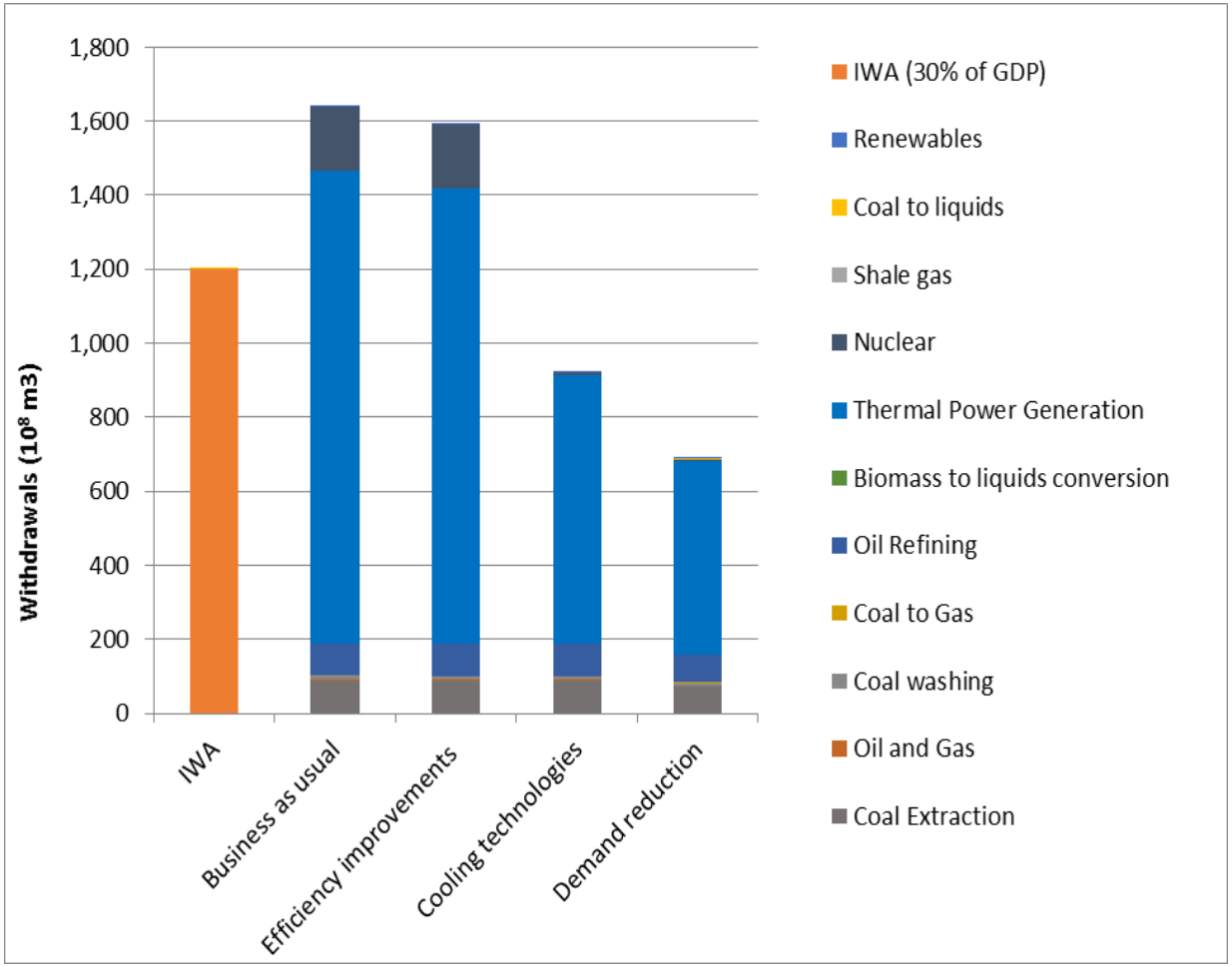
Compliance with water legislation

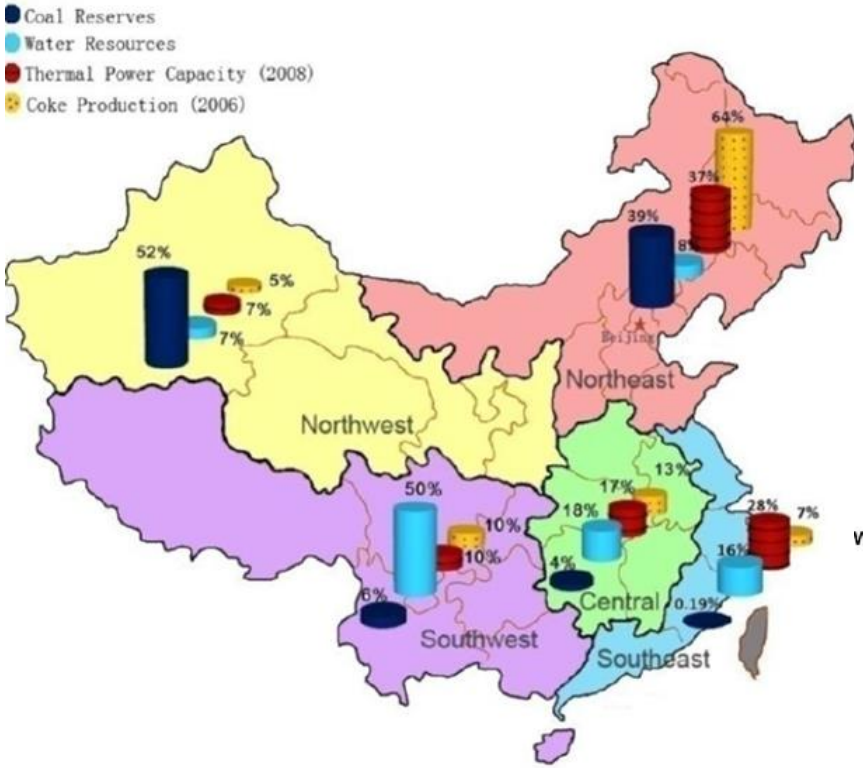


- Could this water legislation limit the growth of certain energy sectors and encourage others?
- Could this water legislation encourage the adoption of certain technologies?

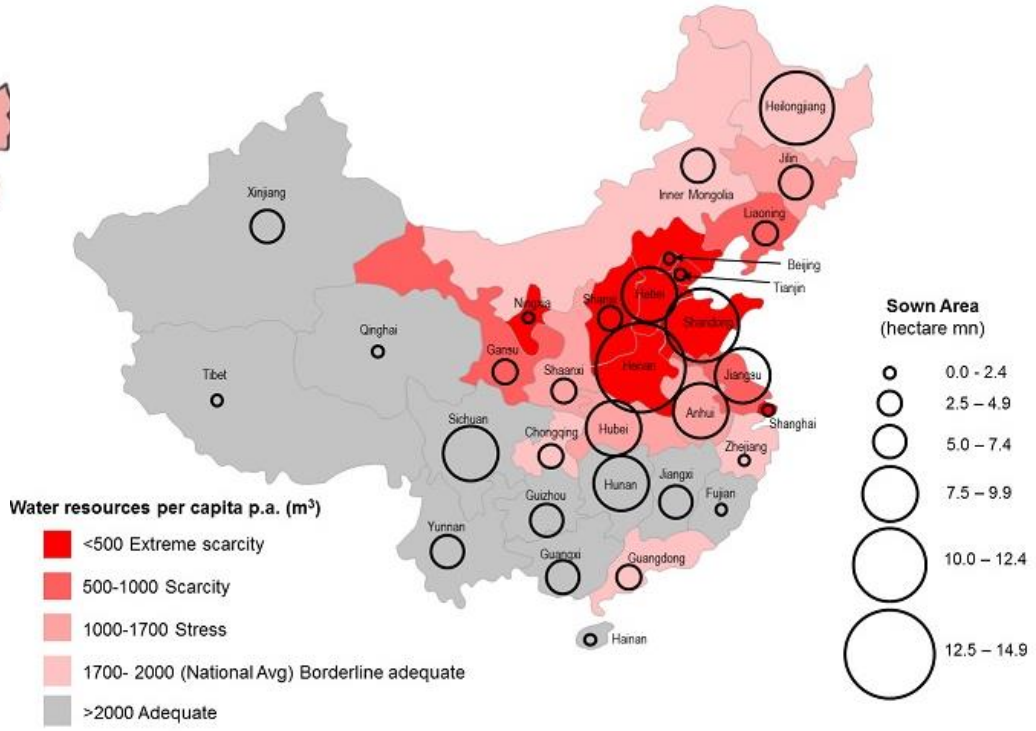
Insights from national analysis

- Links between water and energy in China are extremely important
  - Under a BAU scenario, China's energy sector will not comply with the "3 Red Lines" industrial water policy
  - Water used for energy is highly dependent on technology choices
- Cooling technologies have trade-offs in water withdrawal and consumption
- There are co-benefits and trade-offs between future energy and water plans
- **This study focuses on the demand of water, it is important to also look at the available supply on a regional scale, to determine whether energy scenarios are actually feasible**

Importance of regional analysis and other sectors



Pan et al. (2012), Energy Policy 48, 93-102



China Water Risk (2012)

Most coal and shale gas reserves in China are found in water scarce regions

Need to consider other water users e.g. agriculture and domestic water demands

Thank you

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- For more information: www.foreseer.org
- Email: yq209@cam.ac.uk (Ying Qin)

Extra slides

Future energy scenarios in China

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Scenarios are based on IEA future energy scenarios to 2035 and enriched with supplemental sources.

1) **Current policies scenario**: Implementation of measures in the 12th Five-Year Plan, including a 17% cut in CO2 intensity by 2015 and a 16% reduction in energy intensity by 2015 compared with 2010.

2) **New policies scenario (IEA's central scenario):** 1) 40% reduction in CO2 intensity compared with 2005 by 2020; 2) CO2 pricing by 2020; and 3) Share of 15% of non-fossil fuel in total supply by 2020.

3) **450 Scenario:** 1) 45% reduction in CO2 intensity compared with 2005 by 2020; 2) higher CO2 pricing; and 3) reduction of local air pollutants from 2010 to 2015 (8% for sulphur dioxide, 10% for nitrogen oxides).

Energy and water study in China- methodology

An energy and a water for energy study has been undertaken and visualised using dynamic and connected Sankey diagrams. The study includes:

- Visualising future energy pathways using IEA future scenarios together with additional data from China
- Modelling the water use for different energy processes such as extraction, processing and power generation under different energy pathways and technology
- Analysing the energy sector's water use as compared to industrial water allowed targets
- Analysing the effects that Industrial Value Added has on the amount of industrial water allowed

Future Scenarios

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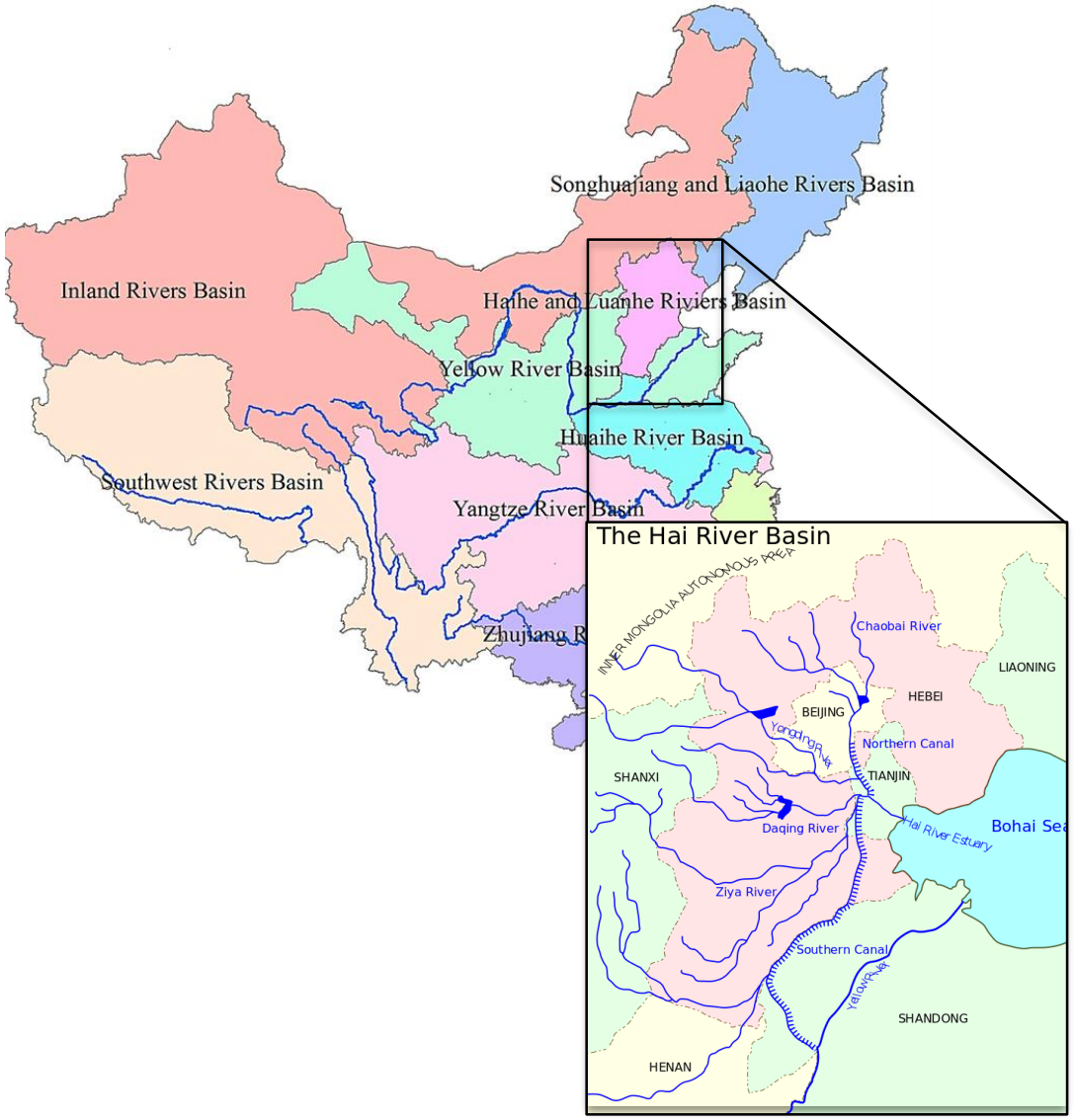
	Business as usual	Efficiency improvements	Cooling technologies	Demand reduction
Objective	Business as usual	Efficiency improvements in power plants	Efficiency improvements + increase in dry cooling and wet tower cooling	Efficiency improvements + cooling technologies + demand reduction and an increase in non-fossil fuels
Energy pathway	IEA Current Policies	IEA Current Policies	IEA Current Policies	IEA New Policies
Coal Power technologies	Same mix as 2010	50% reduction in small plants (replaced by more efficient plants)	Same as “efficiency improvements” scenario	Same as “efficiency improvements” scenario
Nuclear	50% wet tower and 50% once through cooling	50% wet tower and 50% once through cooling	100% wet tower cooling	100% wet tower cooling
Dry cooling	12%	12%	30%	30%

Regional case study: Haihe Basin

- Growing pressures on energy, water and land resources
- One of the most important food production regions in the country
- Capital region – continuing growth in urban areas and industry
- Intense competition for water – lowest water availability per capita out of the nine major river basins (358m3 per cap)
- Region facing serious resource and environment challenges



Modelling shale gas

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