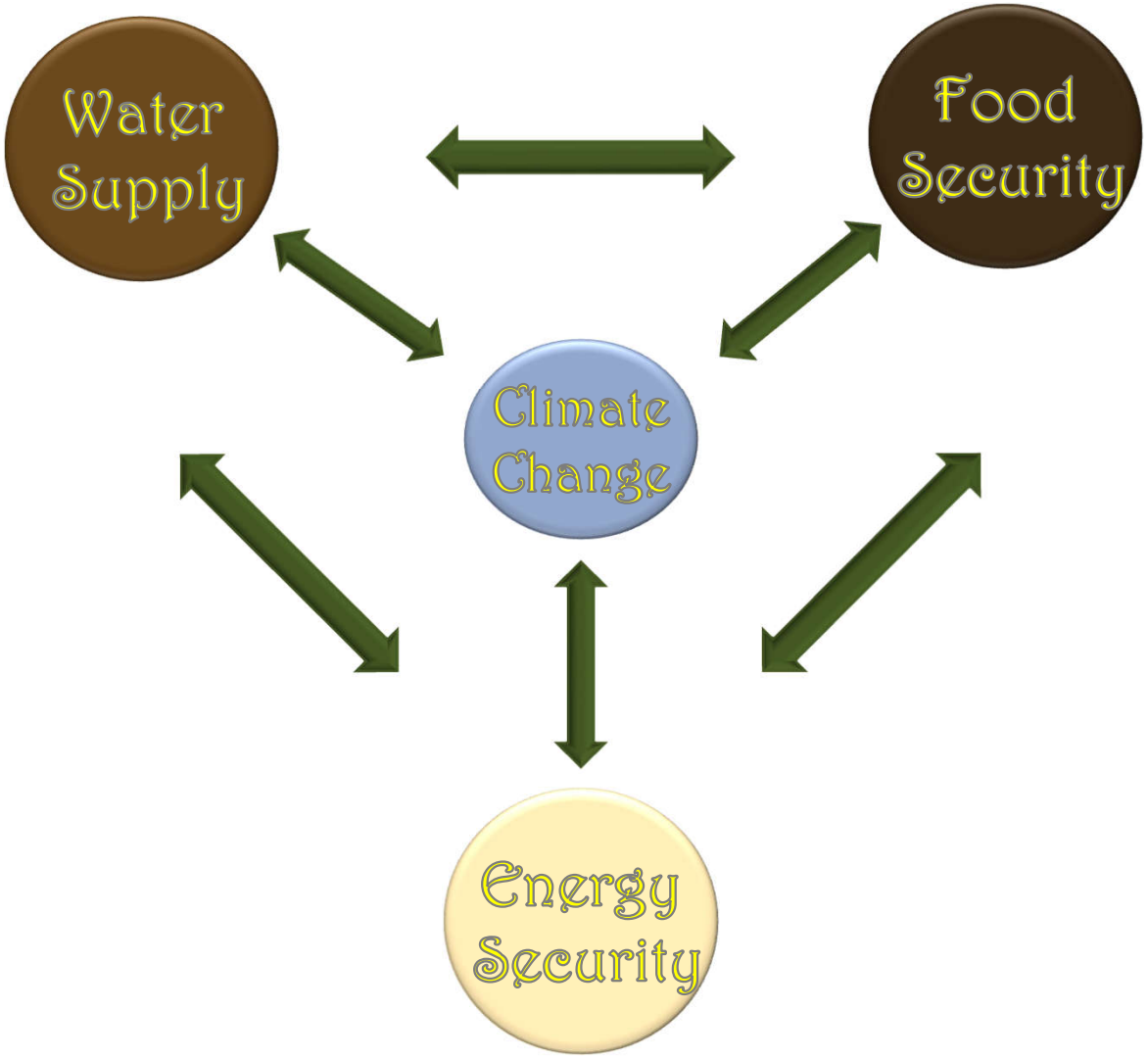
Water -Energy Nexus in China's External Relations and the Implication for China-South Asia Cooperation

Prof. YU Hongyuan
yuhongyua@siis.org.cn
Shanghai Institutes for International Studies

Water-energy-food nexus

- **Water** is the most basic factor of energy and food processing
  - **Production, Life, and Ecology** need abundant and good quality water
  - Water is needed for electricity generation including thermal and nuclear power generation
  - Hydropower is a integrated product of water and energy
- **Water** is the most basic factor of energy and food processing
  - **Production, Life, and Ecology** need abundant and good quality water
  - Water is needed for electricity generation including thermal and nuclear power generation
  - Hydropower is a integrated product of water and energy

- **Water-energy-food nexus**, one problem may lead to other problems.
  - **Water security** is key issue in , water saving is national strategy.
  - **Energy security** is important issue. Hydropower will be focused as one of key renewable energy.
  - **Food security** is top issue in China and India, in which, irrigation agriculture will be emphasized.


Water Supply
Food Security
Climate Change
Energy Security

- As basic factors, water, energy and food shortages are existing in some countries and regions, especially in Least Developed Countries (LCDs)

- **For human being and development,** water is basic, energy is key, and food is fundamental demand.

Backgound to the Water-Energy-Food Nexus

1.Growing Global Population&Urban Population

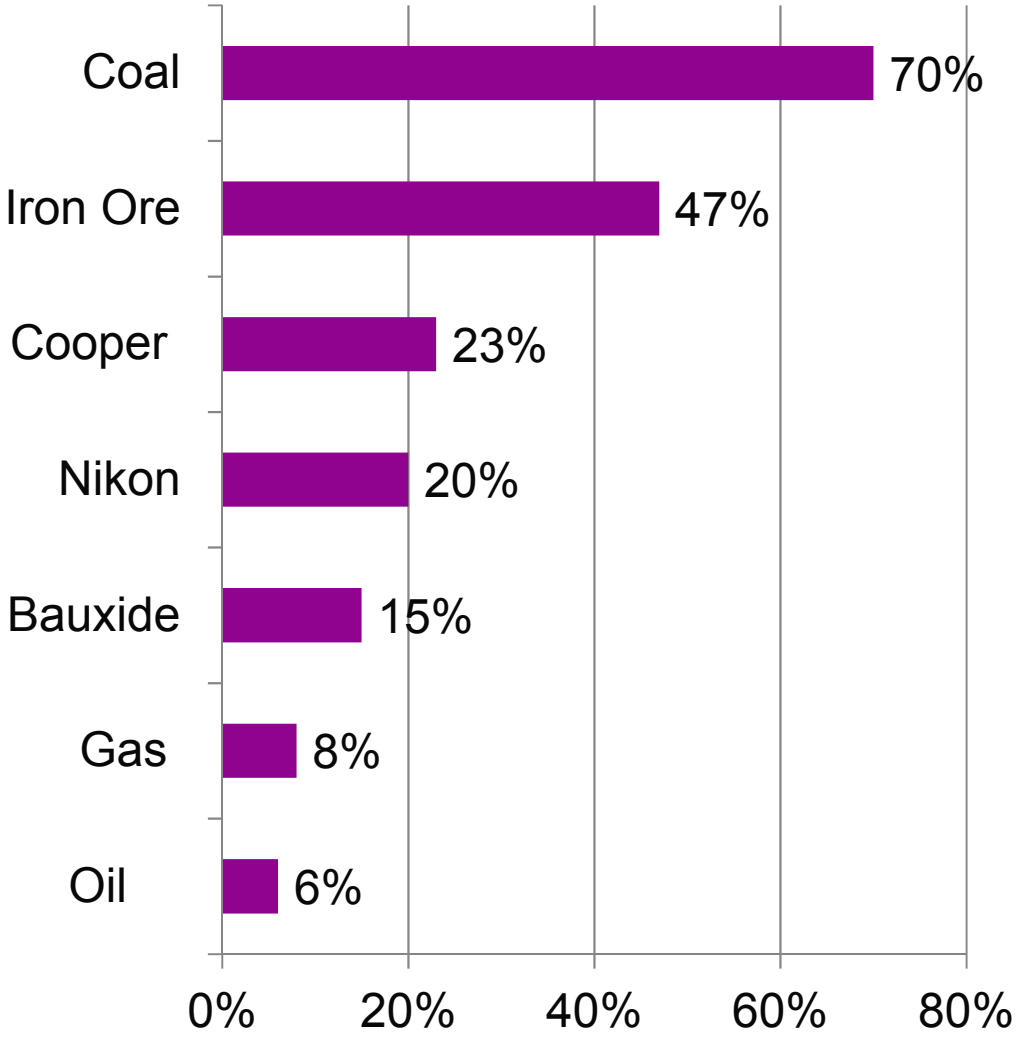
- **World Urbanization Prospects (The 2014 Revision): The world population will rapidly increase to 8 billion by 2025 and to more than 10 billion by 2050, with almost two-thirds of them living in cities. Changes in urbanization processes and consumption patterns tend to increase pressure on water, energy and food security.**

2.Entering into an era of Resource Shortage with eccelerating process of Industrialization in developing countries

- **In the past, 80% global energy resources provided for 10% world population living in industrialized and urbanized countries (U.S., Japan, EU etc.)**
- **Now 70% world population are stepping into industrialization and urbanization, which means the growing demand of energy resource.**

3.Pressure Rising on eco-environmental system, severe pollution of air, land and water

- **Impacts of Climate change can already be seen in water management and agriculture in many areas, the environmental capacity of each country has become increasingly strained.**
- **The consequences of industrial pollution, unsustainable development mode weighs heavily on the low-carbon transformation...**

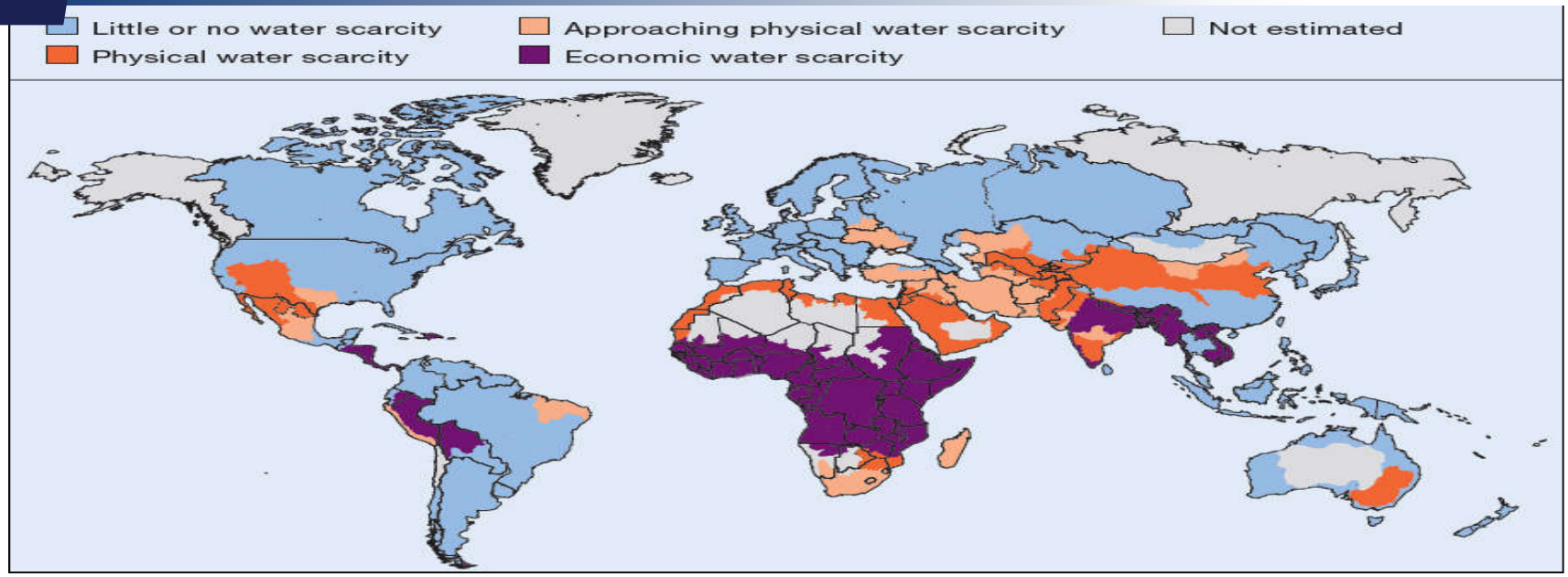


The Proportion of China's Reservation Per Capita to Global Reservation Per Capita

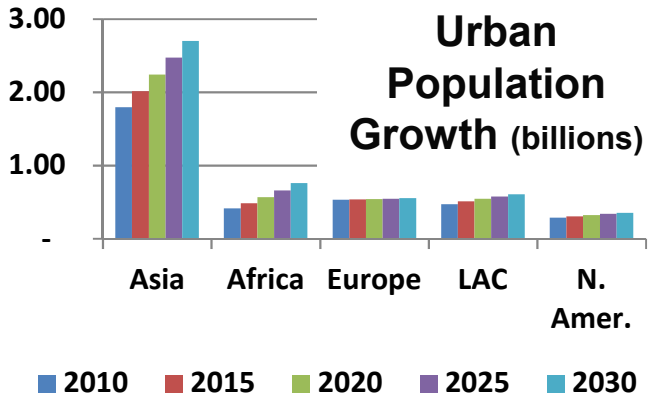
The resource reservation per capita in China is relatively low. It is 10%below the global level in terms of oil and gas reservation per capita, while below 50% in the world for iron, copper, aluminum and nickel. Water is only 6.5%

From 2000 to 2010, the total import of mineral products in China has increased from 59.43 billion dollars to 482.852 billion dollars (almost 3,000 billion RMB in equivalent), which is 17.5% of the GDP.

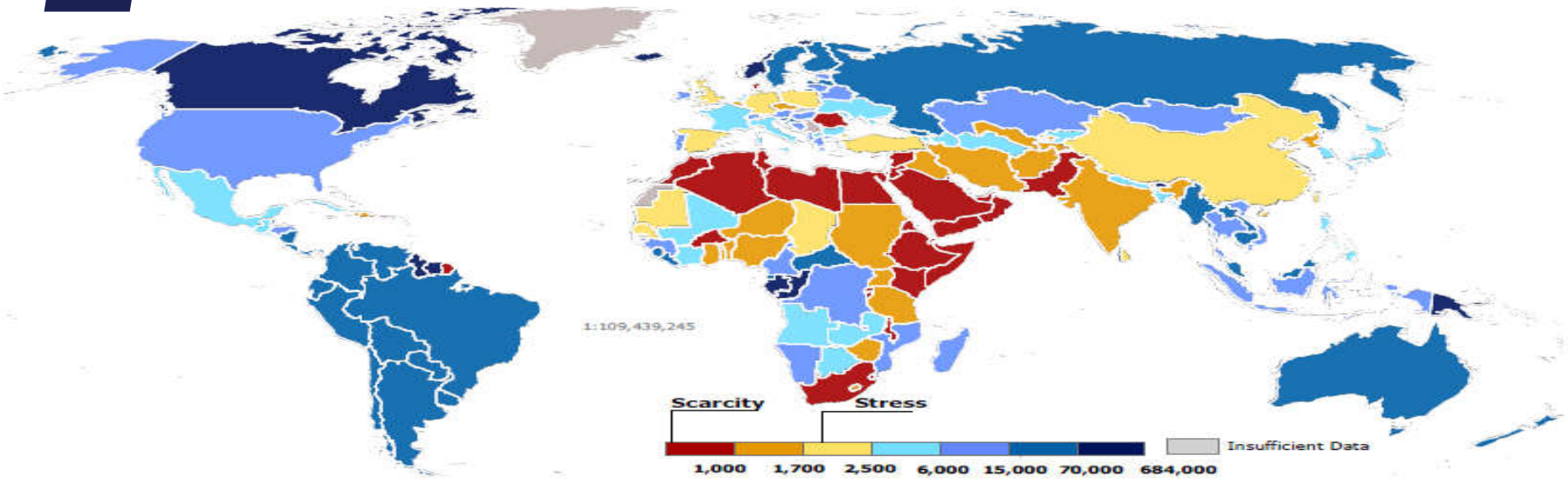
Population Growth



- As populations grow, water demand will increase.
- Managing wastewater in growing urban populations will become a particular challenge that will threaten human and environmental health.
- Those areas in red, will lack sufficient water resources to meet basic needs while those in purple will have enough water available but will lack the financial and/or technical resources to get the water from where it is to where it's needed, when it's needed.



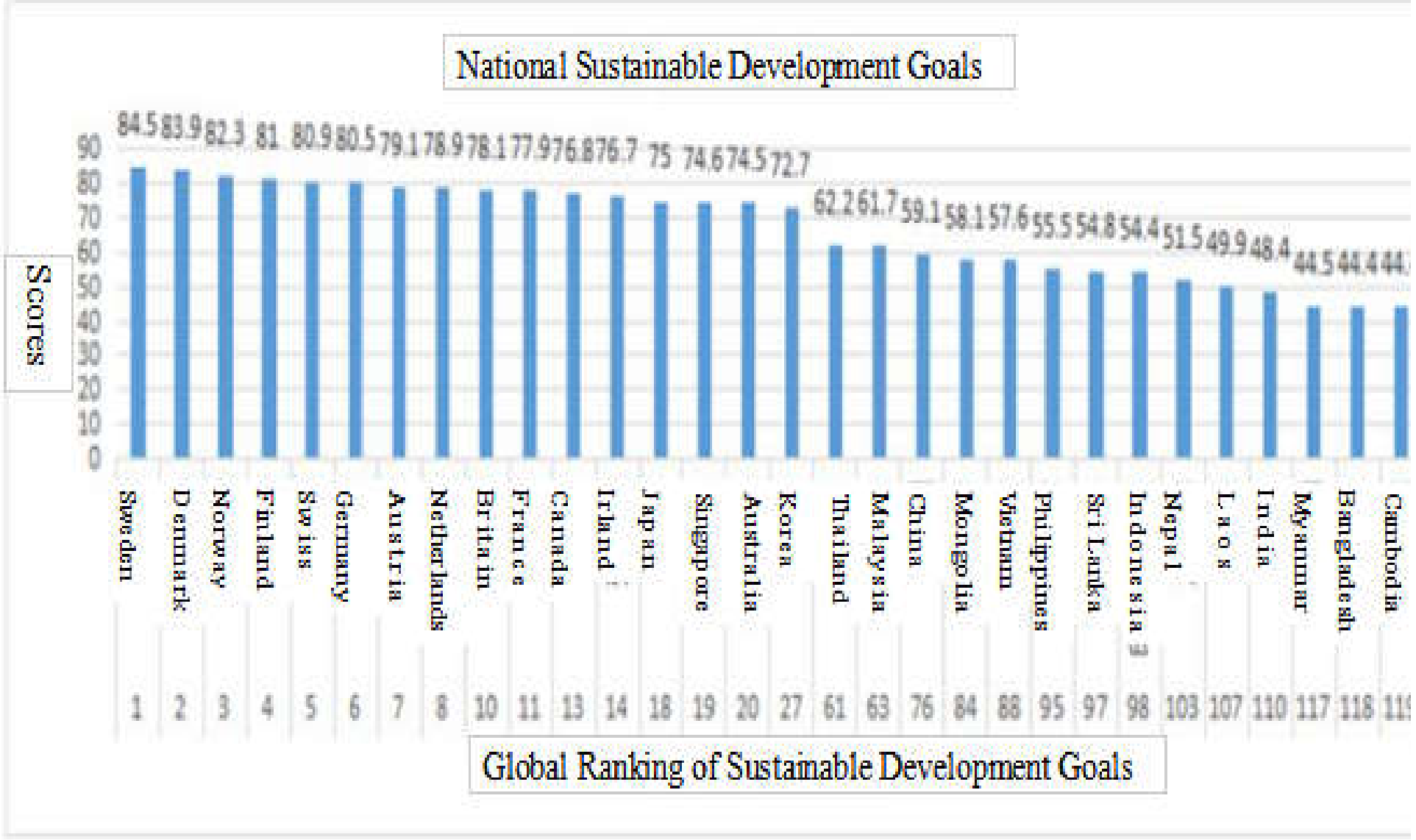
Water Availability 2030



- By 2030, the estimated population growth will push more than 3.3 billion people into “water stress” conditions.
- To adapt, better water management, innovative and wholistic water innovations and tools will be needed.
- New technologies must be researched, developed, and disseminated rapidly and with a focus on he poor. Technology can both help and hurt and often have trade-offs – i.e. desalinization can increase water supplies, but has great energy and ecological costs.
- Water supplies can best be expanded through combination of existing technologies and innovative technologies and a renewed focus and global expansion of water demand management, and water efficiency innovations.

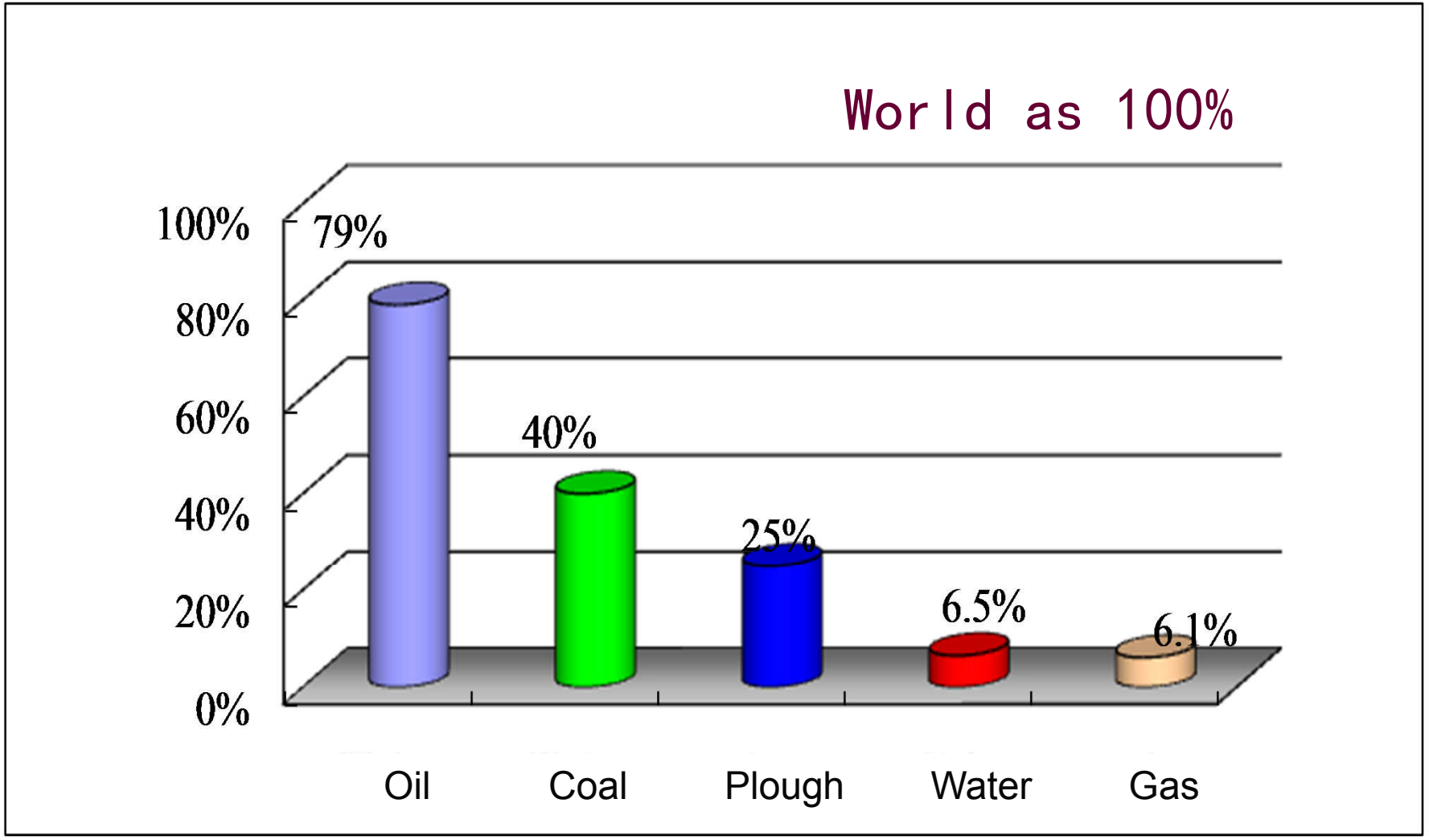
Source: FAO Aquastat Database, World Resources Institute – Earth trends, and the National Academy of Sciences

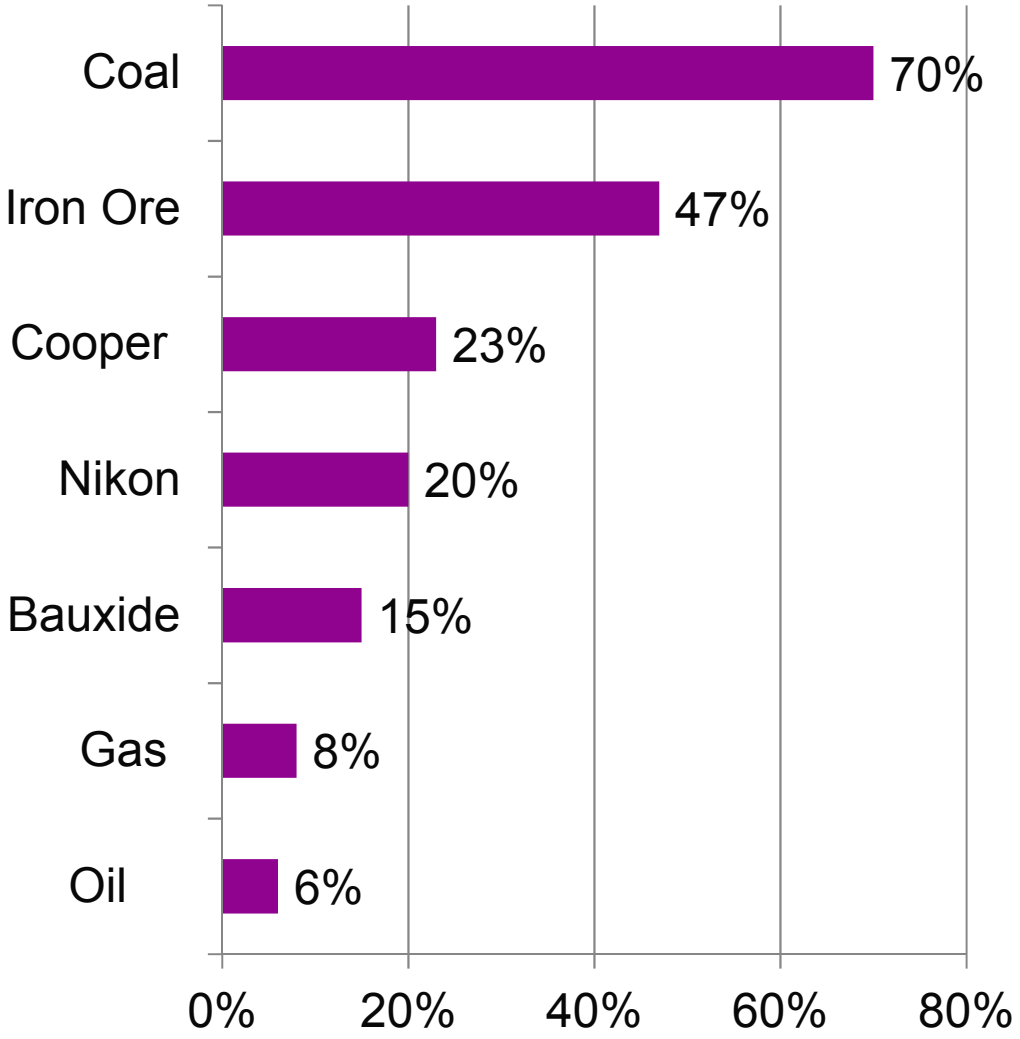
The sustainable supply of public goods supply is important and urgent



Nexus Challenges for China

China Per Capita Water-energy-food



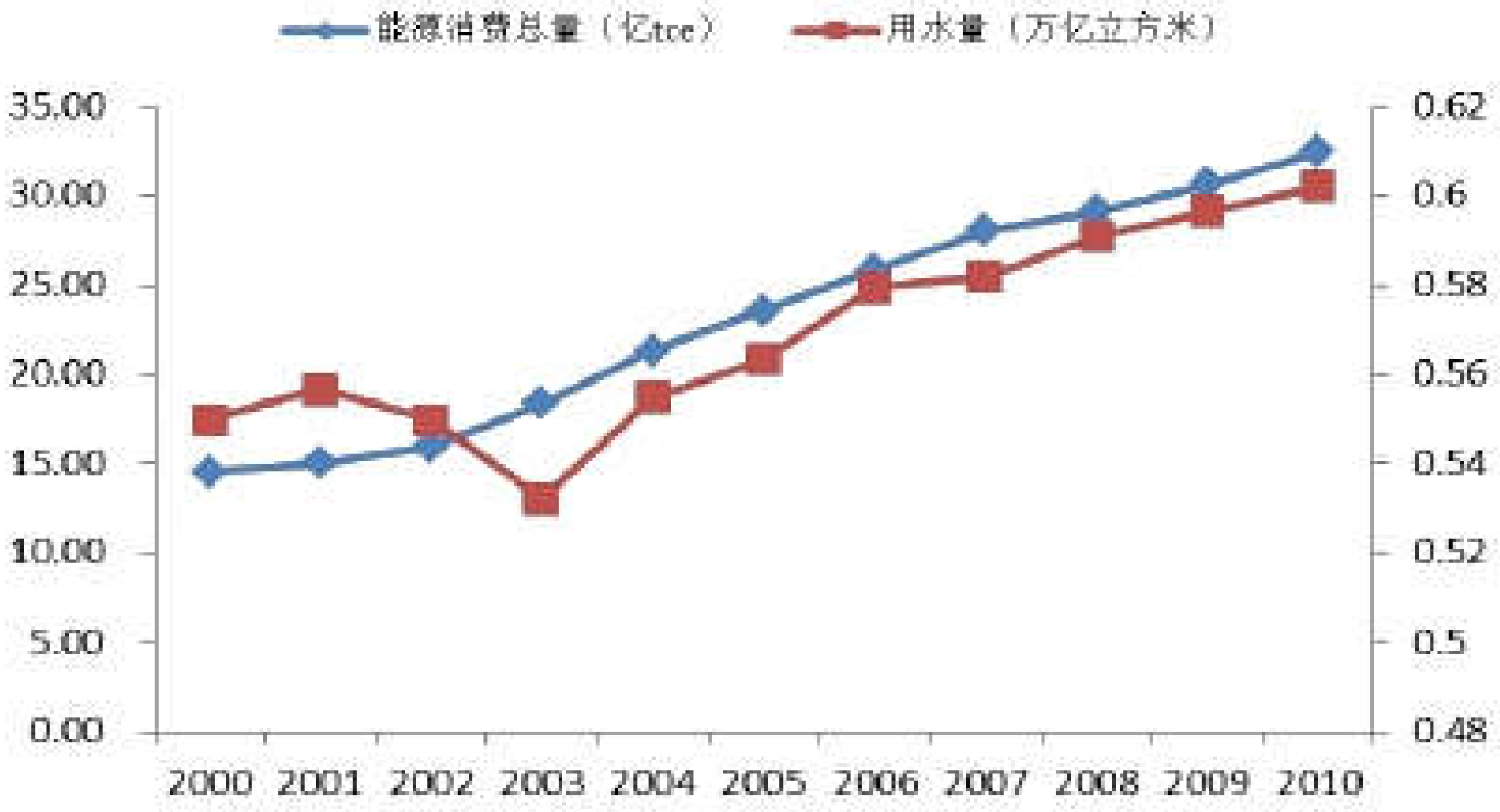


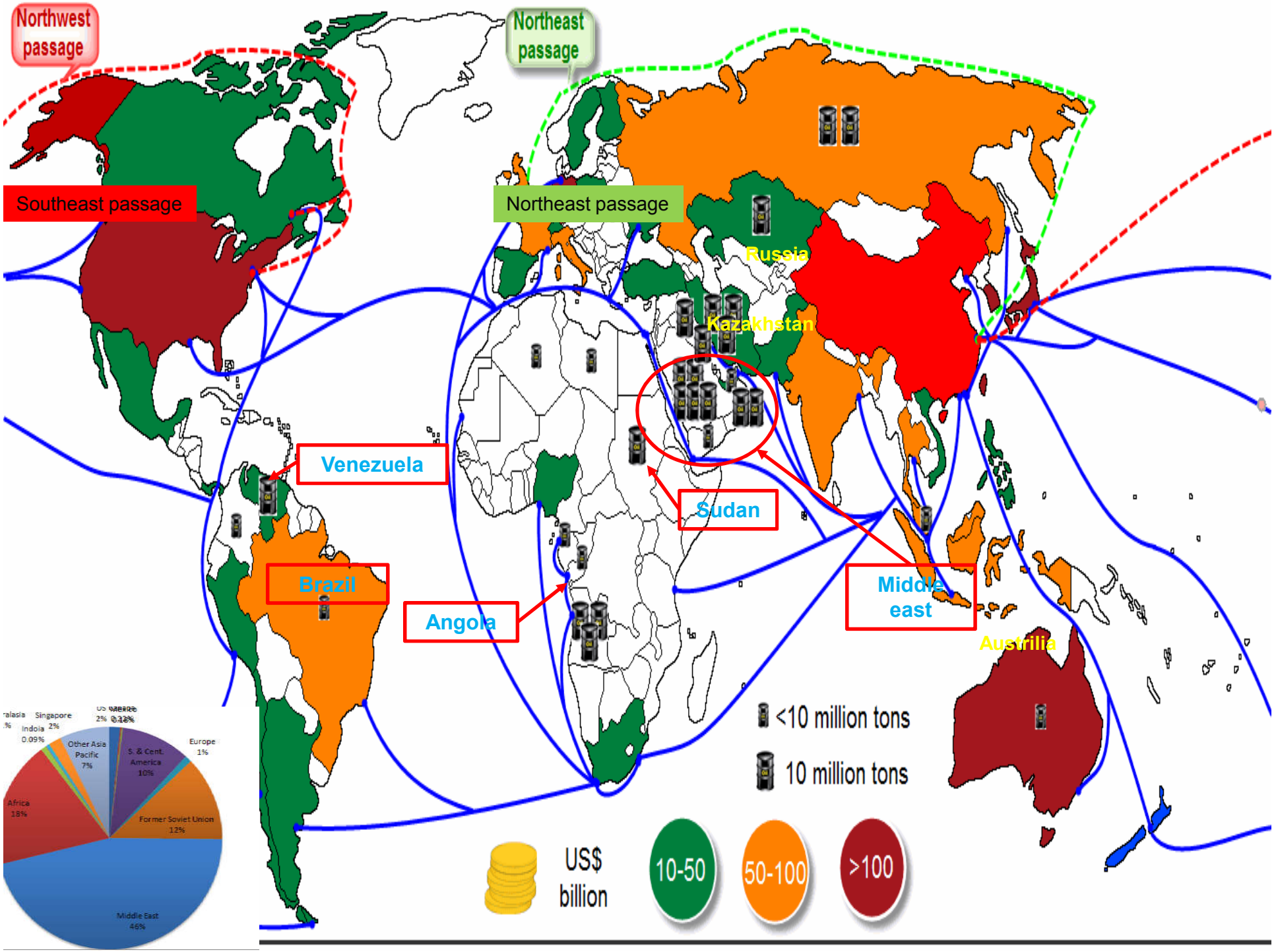
The Proportion of China's Reservation Per Capita to Global Reservation Per Capita

The resource reservation per capita in China is relatively low. It is 10%below the global level in terms of oil and gas reservation per capita, while below 50% in the world for iron, copper, aluminum and nickel. Water is only 6.5%

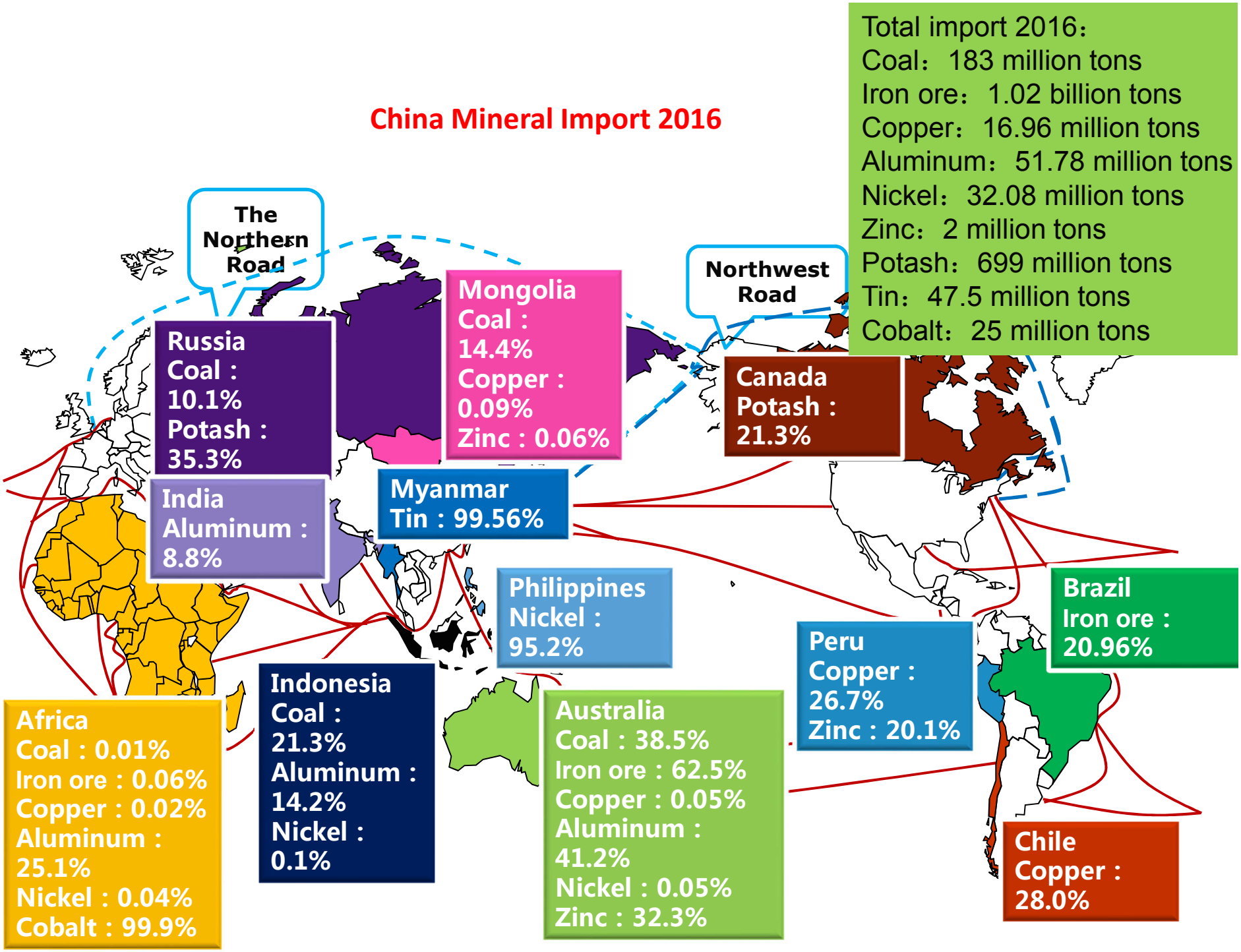
From 2000 to 2010, the total import of mineral products in China has increased from 59.43 billion dollars to 482.852 billion dollars (almost 3,000 billion RMB in equivalent), which is 17.5% of the GDP.

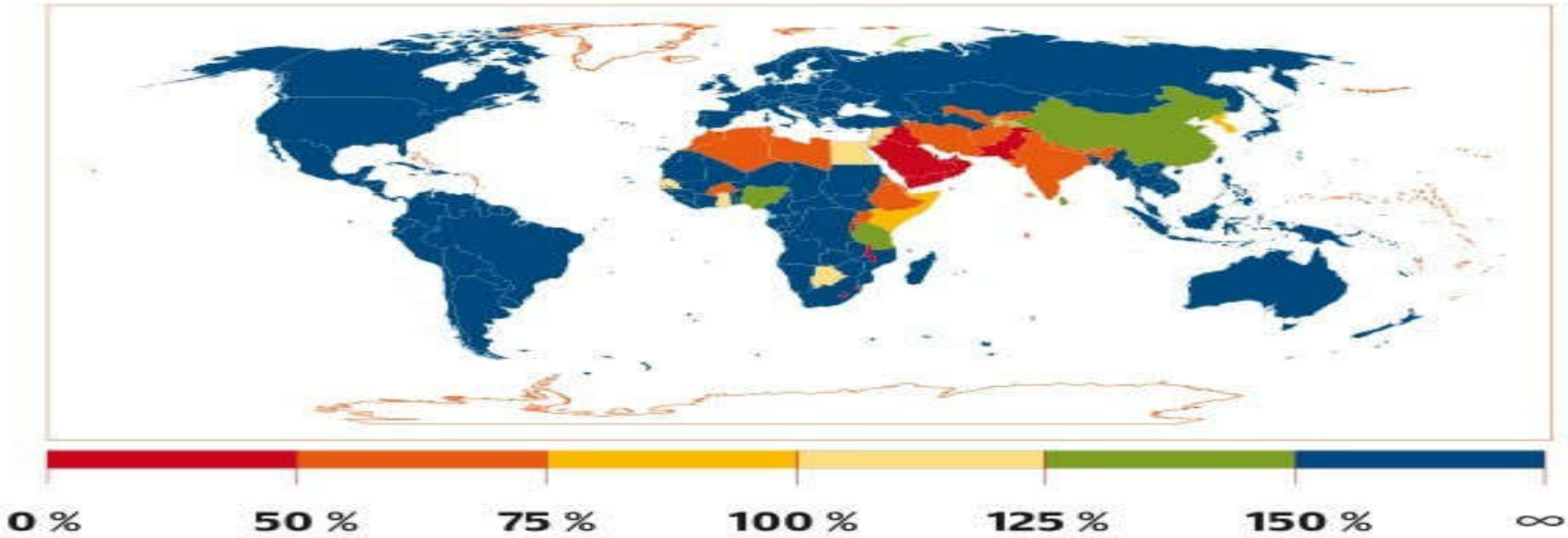
Relationship Between Energy and Water in China

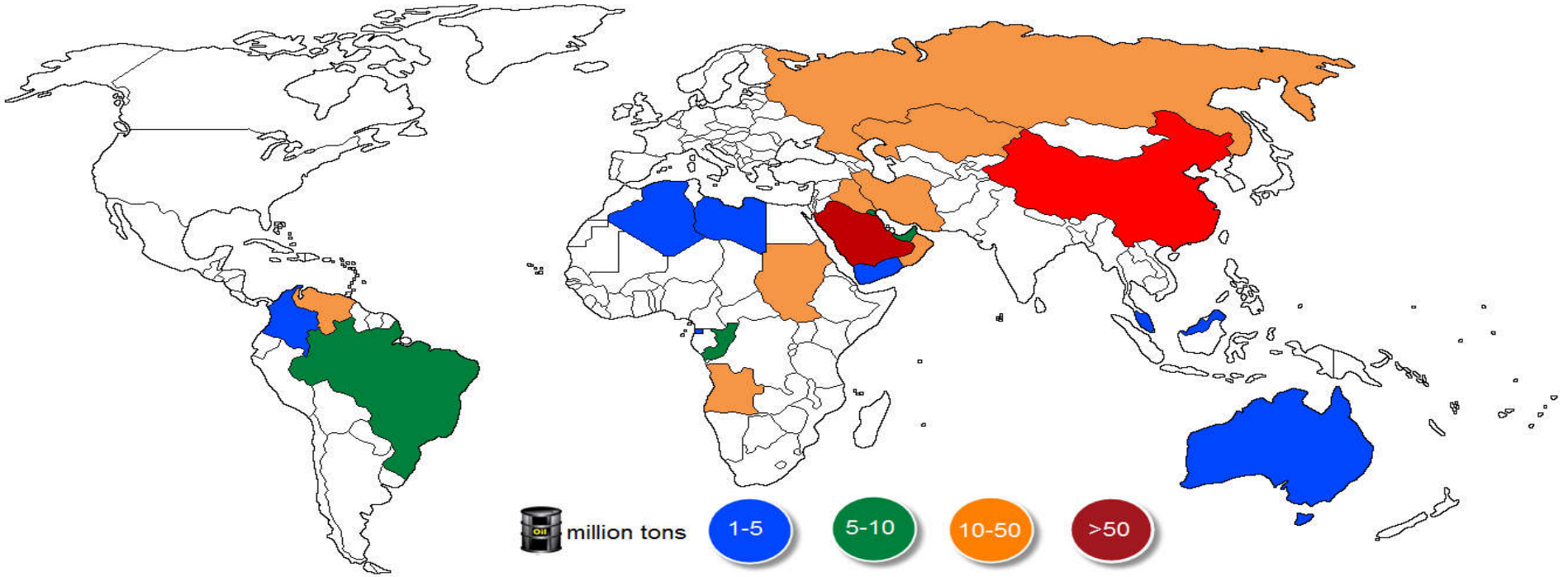


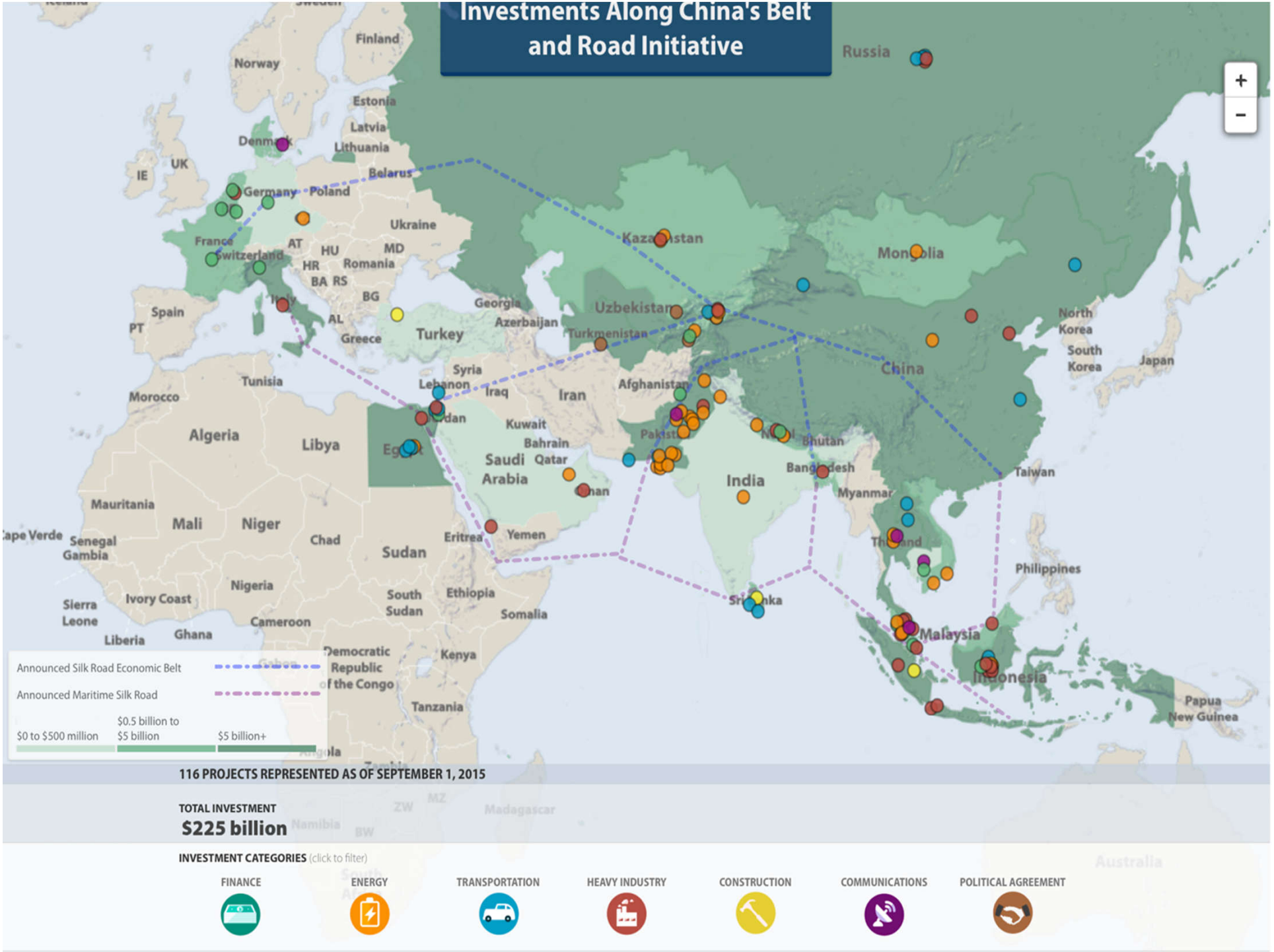

Northwest passage
Northeast passage
Southeast passage
Northeast passage
Russia
Kazakhstan
Venezuela
Sudan
Brazil
Angola
Middle east
Austrilia
<10 million tons
10 million tons
US$ billion
10-50
50-100
>100
Singapore 2%
Indola 0.09%
Other Asia Pacific 7%
S. & Cent. America 10%
Europe 1%
Former Soviet Union 12%
Middle East 46%
Africa 18%

China Mineral Import 2016

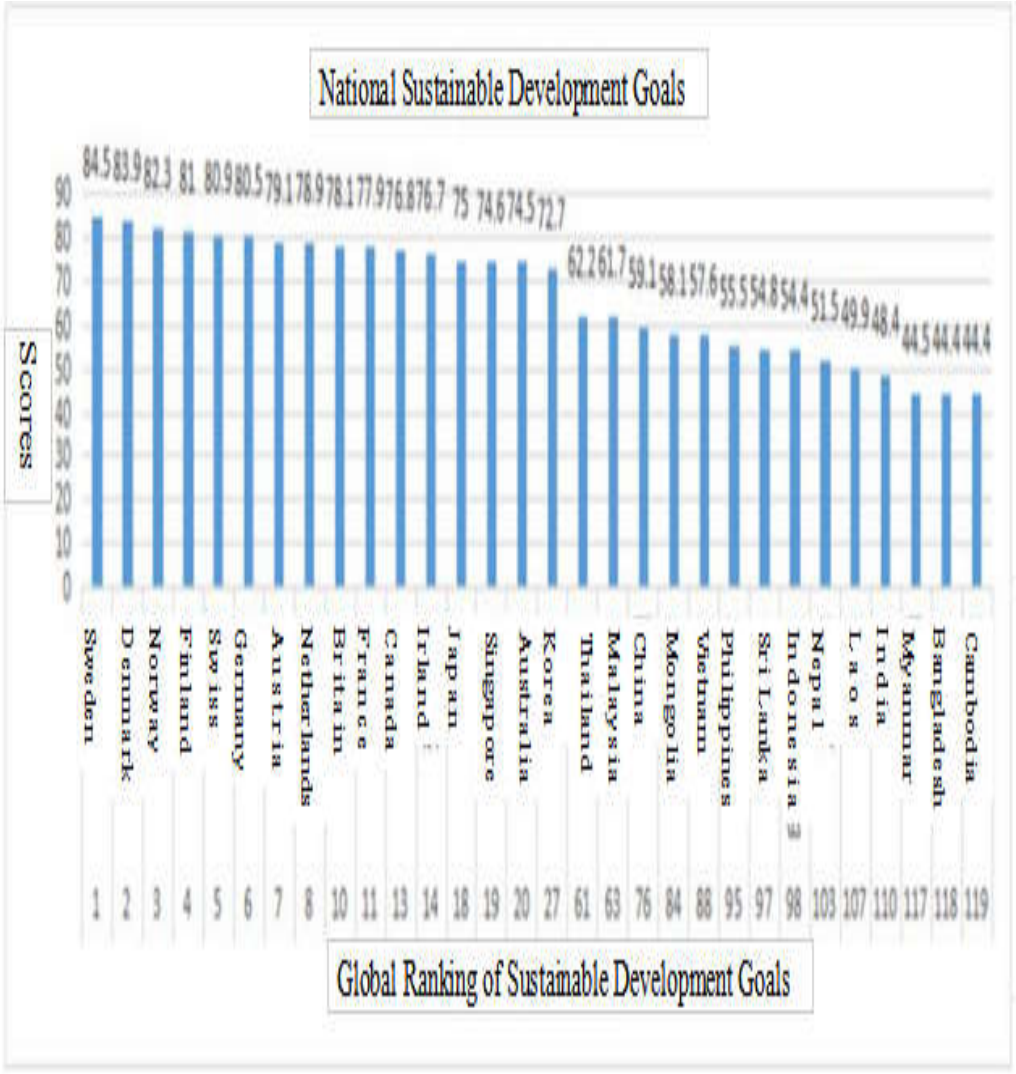


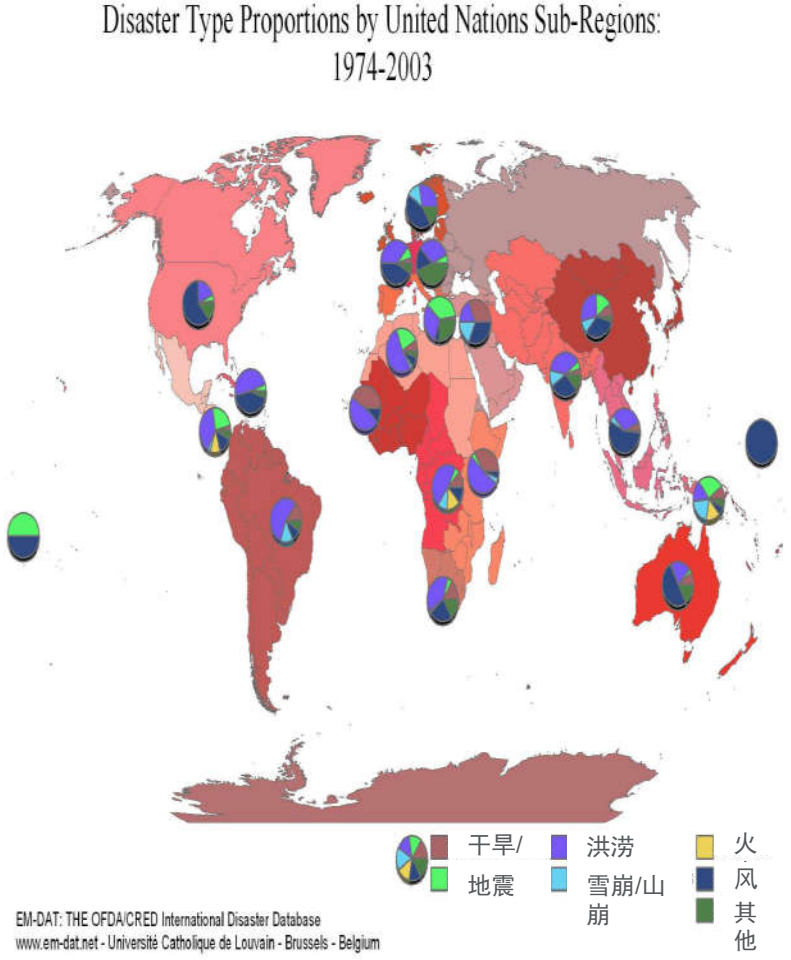

0 %
50 %
75 %
100 %
125 %
150 %
∞


million tons
1-5
5-10
10-50
>50


Investments Along China's Belt and Road Initiative
Russia
Finland
Norway
Estonia
Latvia
Lithuania
Denmark
UK
IE
Belarus
Germany
Poland
Ukraine
France
AT
HU
MD
Switzerland
HR
Romania
BA
RS
BG
Spain
PT
Georgia
Azerbaijan
Uzbekistan
Turkmenistan
Kazakhstan
Mongolia
AL
Greece
Turkey
North Korea
South Korea
Japan
China
Syria
Lebanon
Iraq
Iran
Afghanistan
Tunisia
Morocco
Algeria
Libya
Egypt
Kuwait
Bahrain
Qatar
Saudi Arabia
Pakistan
Bhutan
India
Taiwan
Myanmar
Mauritania
Mali
Niger
Chad
Sudan
Eritrea
Yemen
Cape Verde
Senegal
Gambia
Philippines
Nigeria
Ivory Coast
Sierra Leone
Liberia
Ghana
Cameroon
South Sudan
Ethiopia
Somalia
Malaysia
Democratic Republic of the Congo
Kenya
Tanzania
Indonesia
Papua New Guinea
Namibia
Madagascar
Australia
Announced Silk Road Economic Belt
Announced Maritime Silk Road
$0 to $500 million
$0.5 billion to $5 billion
$5 billion+
116 PROJECTS REPRESENTED AS OF SEPTEMBER 1, 2015
TOTAL INVESTMENT
$225 billion
INVESTMENT CATEGORIES (click to filter)
FINANCE
ENERGY
TRANSPORTATION
HEAVY INDUSTRY
CONSTRUCTION
COMMUNICATIONS
POLITICAL AGREEMENT

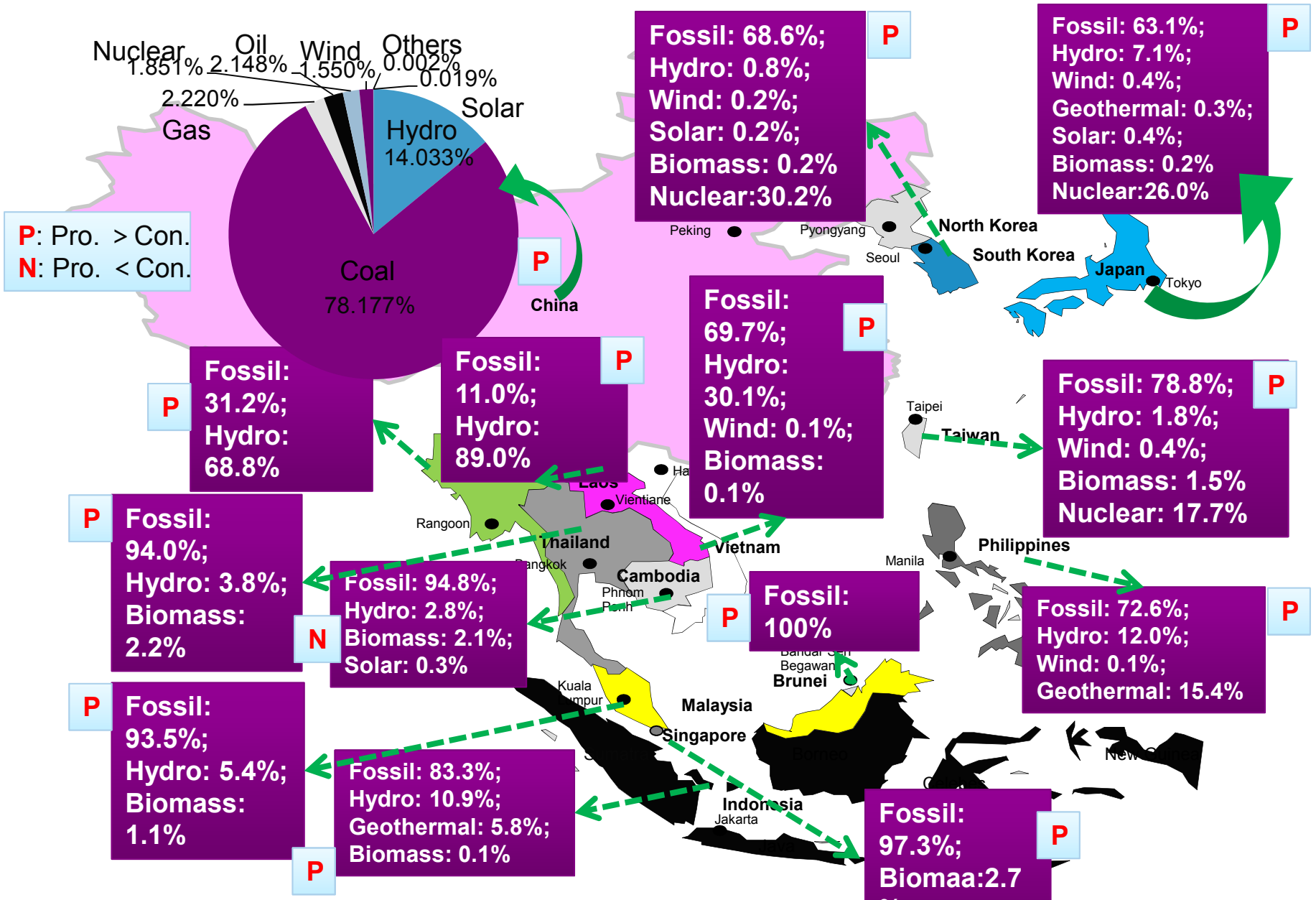
The sustainable supply of public goods supply is important and urgent





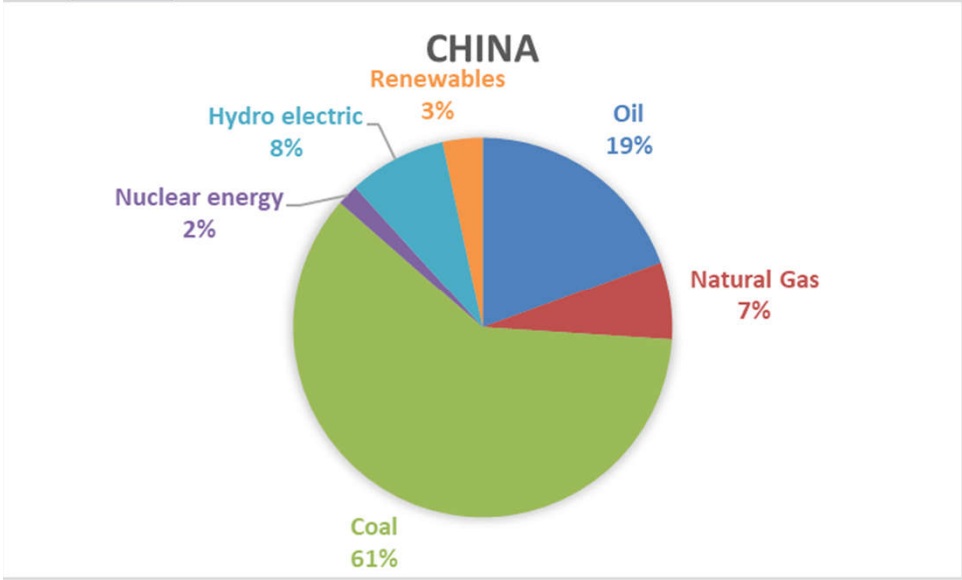
Energy is the Nexus to Water Governance

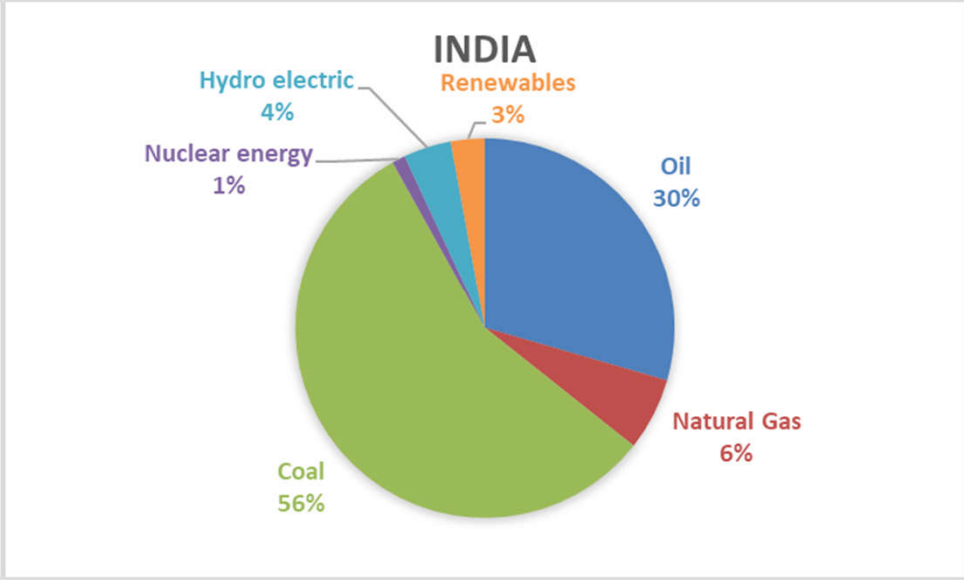
Energy Pro.&Con. _ Electricity

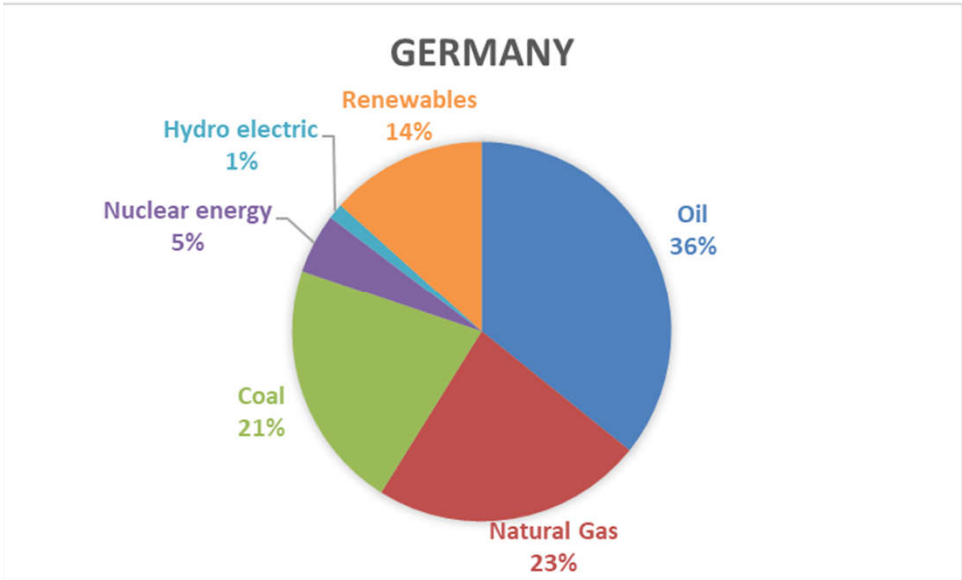


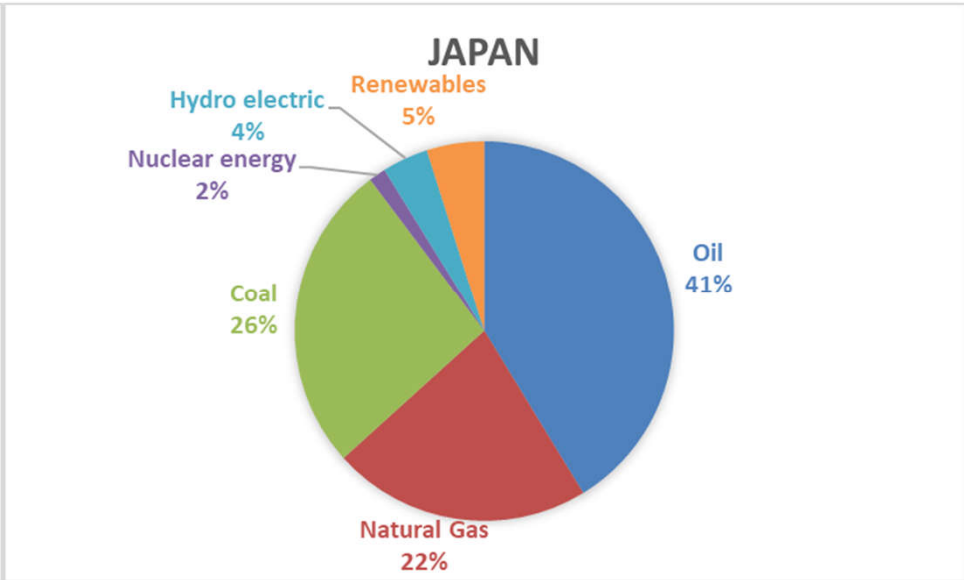
Data source: U.S. Energy Information Administration (EIA) & National Bureau of Statistic of China (NBSC)

Primary Energy: Consumption by fuel







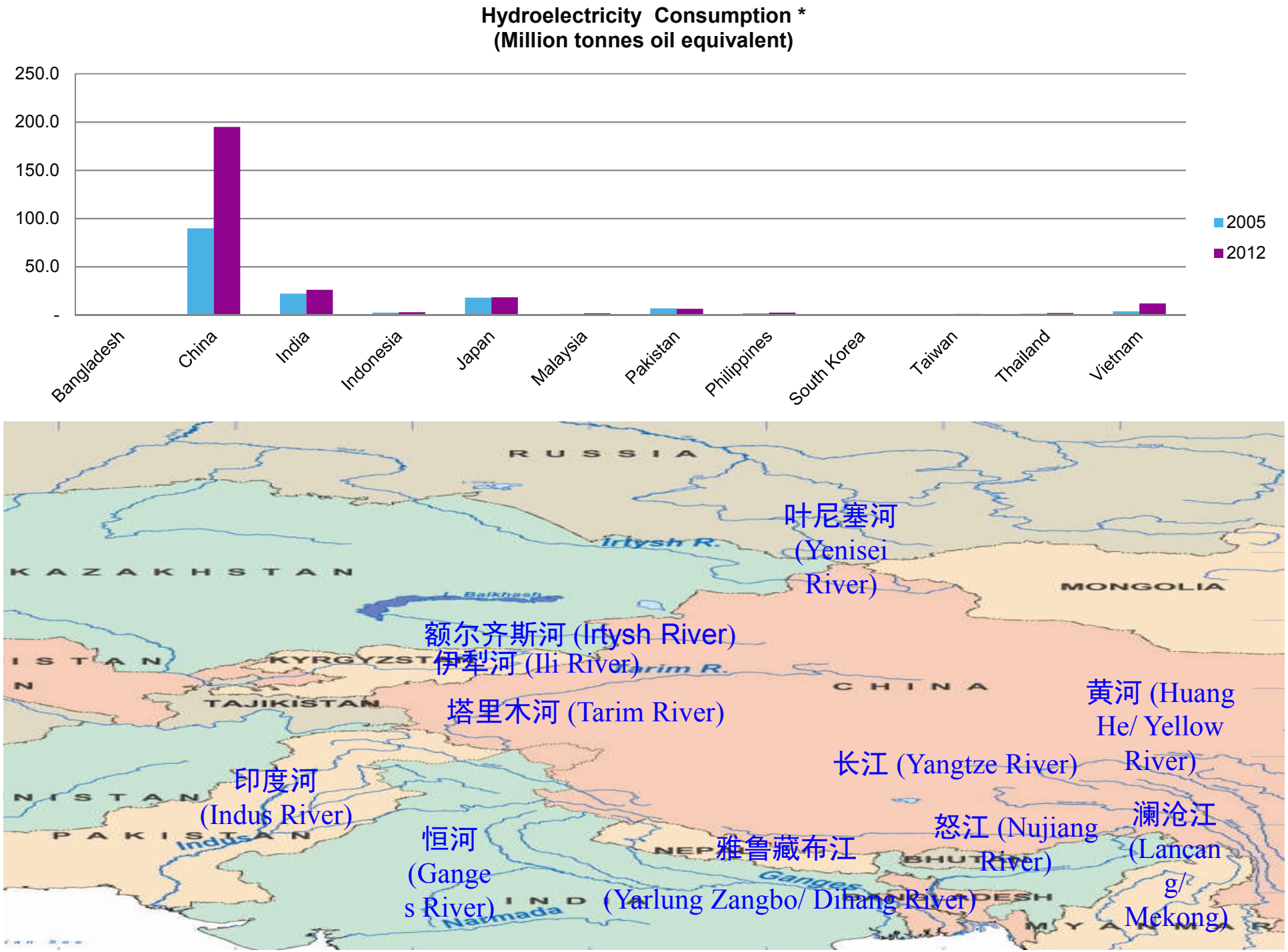


Role and perspective of Hydropower in China

- Hydropower is the dominant renewable energy in the world. The first hydropower in China has been operated over 100 years. (Yunnan Province)

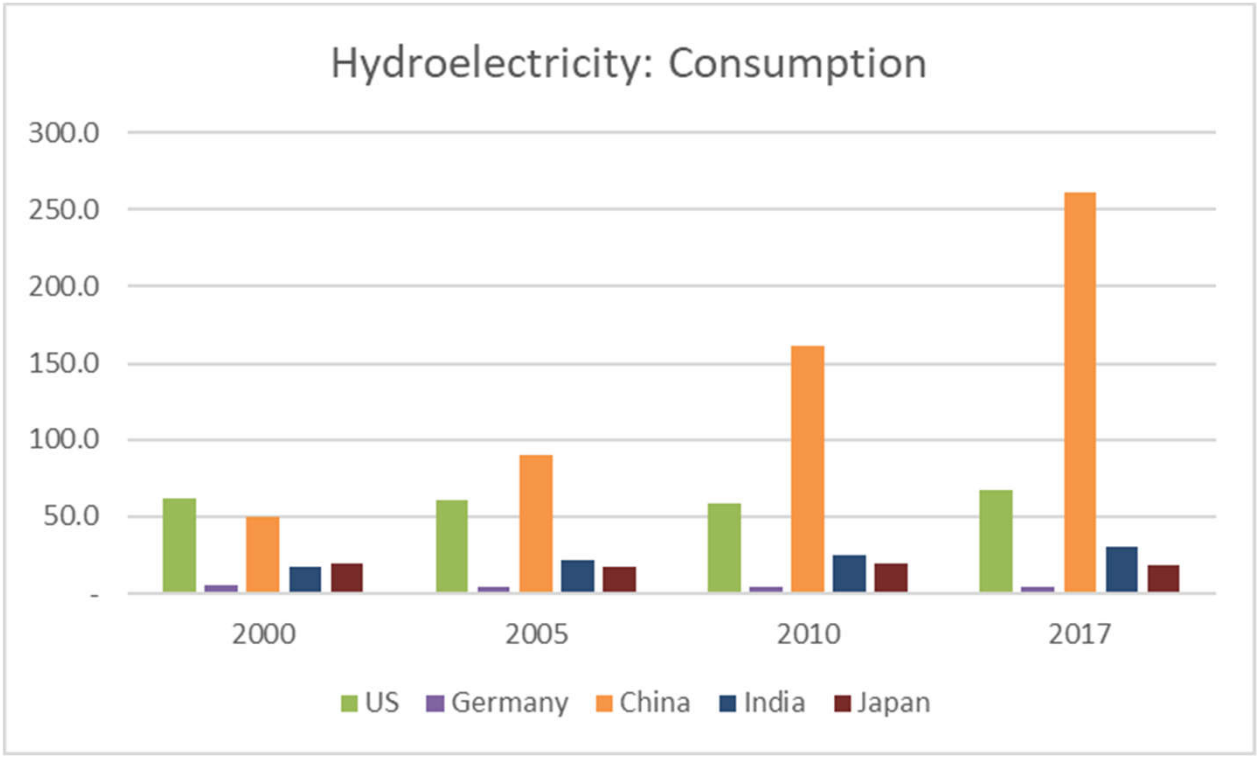
  Renewable energy, including hydropower, instead of fossil energy is a trend/strategy in the world.

  Hydropower is a succeeded technology. After Fukushima nuclear power station disaster, hydropower were recalled attention.

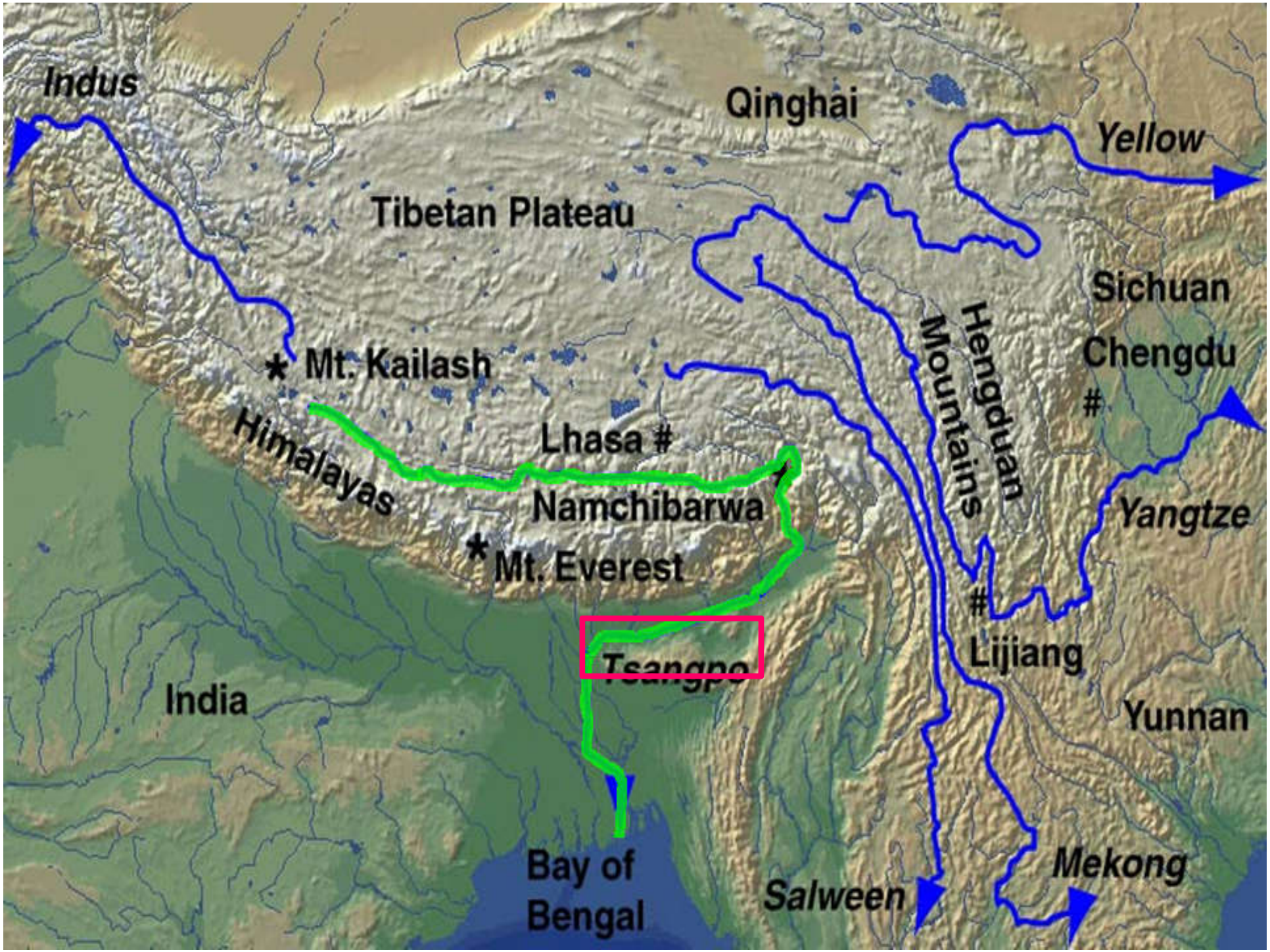

Hydroelectricity Consumption *
(Million tonnes oil equivalent)
250.0
200.0
150.0
100.0
50.0
-
2005
2012
Bangladesh
China
India
Indonesia
Japan
Malaysia
Pakistan
Philippines
South Korea
Taiwan
Thailand
Vietnam
RUSSIA
KAZAKHSTAN
MONGOLIA
CHINA
TAJIKISTAN
PAKISTAN
叶尼塞河 (Yenisei River)
额尔齐斯河 (Irtysh River)
伊犁河 (Ili River)
塔里木河 (Tarim River)
黄河 (Huang He/ Yellow River)
长江 (Yangtze River)
印度河 (Indus River)
恒河 (Ganges River)
雅鲁藏布江 (Yarlung Zangbo/ Dihang River)
怒江 (Nujiang River)
澜沧江 (Lancang/ Mekong)

Hydroelectricity: Consumption

Million tonnes oil equivalent	2000	2005	2010	**2017**
US	61.7	60.3	58.2	**67.1**
Germany	5.6	4.4	4.7	**4.5**
China	50.3	89.8	161.0	**261.5**
India	17.4	22.0	24.6	**30.7**
Japan	19.7	17.4	19.7	**17.9**

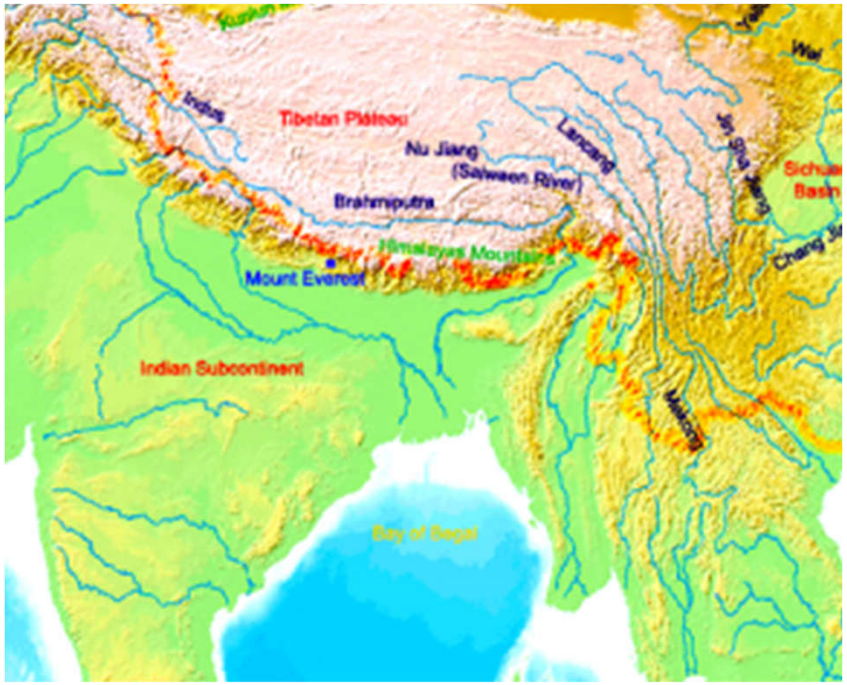


The Case for China-South Asia Cooperation


Indus
Qinghai
Yellow
Tibetan Plateau
Sichuan
Chengdu
Hengduan
Mountains
Mt. Kailash
Himalayas
Lhasa
Namchibarwa
Yangtze
Mt. Everest
Lijiang
Tsangpo
India
Yunnan
Bay of
Bengal
Salween
Mekong

Reasons for Increased Concern for Water Security

- Depleting Supply and Driving Demand
- Global Warming
- Domestic
  - Water Management
  - Water Development
- International
  - Water Management
  - Water Development

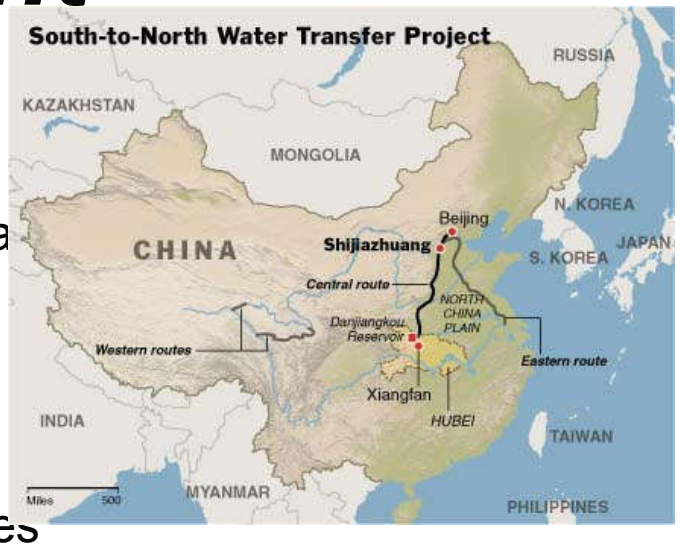


International Water Management

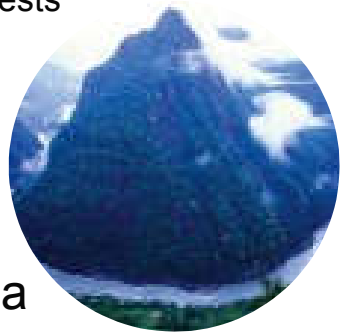
- Past Problems
  - Ineffective methods of seeking control, through:
    - national visions
    - covert appropriation and
    - Exclusively bilateral negotiations and bargaining
  - Result: little regional cooperation in South Asia, least of all concerning water
- Hope for the Future?
  - Latest negotiations:
    - Open a wider range of issues for negotiation
    - Expand the range of negotiating bodies beyond national governments

International Water Development

- Uncertainty regarding upstream development



- Exacerbating Factors
  - Pre-existing mistrust between the China & India
    - Unresolved border disputes
    - Nuclear Competition between India and Pakistani (China assists Pakistani consistently)
    - Lack of transparency regarding previous projects
      - Zangmu Dam
  - China's growing scarcity of local water resources
    - Key causes: population, economic growth, desertification, & increasing pollution
    - China is already bordering the 'water stress' benchmark; many Chinese regions already face severe water shortages, especially in the north.
      - Water stress: per capita availability of 1,700 m^3 per year
    - Food Insecurity
      - 2001: Water shortages were responsible for a loss of 17% of annual harvests



- Suggestions
  - Focus on counterbalancing rather than criticizing or ignoring Chinese ambitions
  - Adopt an "alliance" + "issue linkage" approach regarding China

Ganges-Brahmaputra-Meghna*

Total area: 1,634,900 km²

Countries	Area of Basin in Country km²	%
India	948,400	58.01
China	321,300	19.65
Nepal	147,400	9.01
Bangladesh	107,100	6.55
India, claimed by China	67,100	4.11
Bhutan	39,900	2.44
India control, claimed by China	1,200	0.07
Myanmar (Burma)	80	0.00

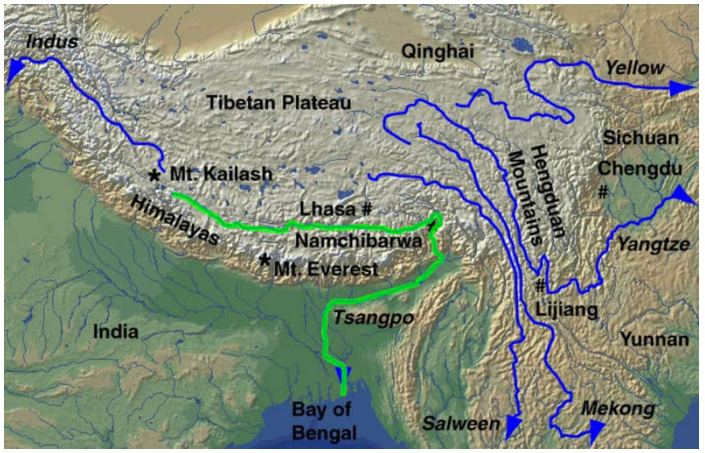
Date	Treaty Basin	Signatories	Treaty Name
December 12, 1996	Ganges	Bangladesh, People's Republic of; India, Republic of	Treaty between the government of the Republic of India and the government of the People's Republic of Bangladesh on sharing of the Ganga/Ganges waters at Farakka
February 12, 1996	Mahakali	India; Nepal	Treaty between His Majesty's government of Nepal and the government of India concerning the integrated development of the Mahakali River including Sarada Barrage, Tanakpur Barrage, and Pancheshwar Project
July 20, 1983	Ganges	Bangladesh; India	Meeting of the Joint Rivers Commission
July 20, 1983	Teesta/Tista	Bangladesh; India	Agreement on ad hoc sharing of the Teesta waters between India and Bangladesh reached during the 25th meeting of the Indo-Bangladesh Joint Rivers Commission held in July 1983, in Dhaka
October 7, 1982	Ganga/Ganges	Bangladesh; India	Indo-Bangladesh memorandum of understanding on the sharing of Ganga waters at Farakka
April 7, 1978	Kosi	India; Nepal	Agreement between Nepal and India on the renovation and extension of Chandra Canal, Pumped Canal, and distribution of the Western Kosi Canal
November 5, 1977	Ganges	Bangladesh, People's Republic of; India, Republic of	Agreement between the government of the People's Republic of Bangladesh and the government of the Republic of India on sharing of the Ganges waters at Farakka and on augmenting its flows
November 24, 1972	Ganges-Brahmaputra	Bangladesh; India	Statute of the Indo-Bangladesh Joint Rivers Commission
December 19, 1966	Kosi	India; Nepal	Amended agreement between His Majesty's government of Nepal and the government of India concerning the Kosi Project

- India & Bangladesh have established a Joint Rivers Commission
- India & Pakistan reached a water-sharing agreement concerning the Indus River
- **India & China currently lack a comparable treaty or organization.**

India & China Interaction

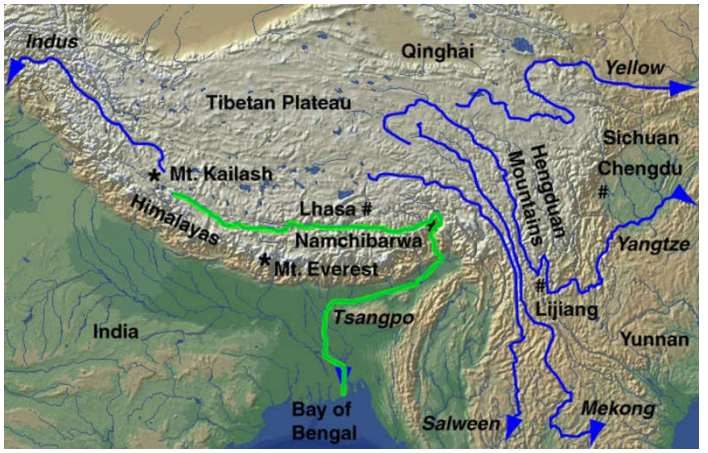
Brahmaputra (Yarlung Zangbo River)

- China - India Interaction
  - After 2006, the joint statement on the exchange of visits between the two countries would mention the issue of water resources in China and India
- Indian Perspective
  - hydropower
  - India has undergone extensive development and remains highly vigilant about any development activities in China.
- China's Perspective
  - China responded prositively and provided complete hydrological data to prove that China's Zangbo hydropower station would not affect the middle and lower reaches.
  - Further develop the Yarlung Zangbo River



Brahmaputra (Yarlung Zangbo River)
India & China Interaction

- At Present
  - China and India only have a bilateral mechanism but does not have multilateral ones.
  - China-India-Myanmar economic corridor progressed slowly, and the main resistance is from India.
  - China's now in a relatively dominant position.
    - China is now relatively richer in energy, whose power output is far more than that of the United States, but still cannot take others lightly.
    - South Asia countries are so backward in development, and so short of energy.
- In the Future
  - China can promote multilateral cooperation through water governance.



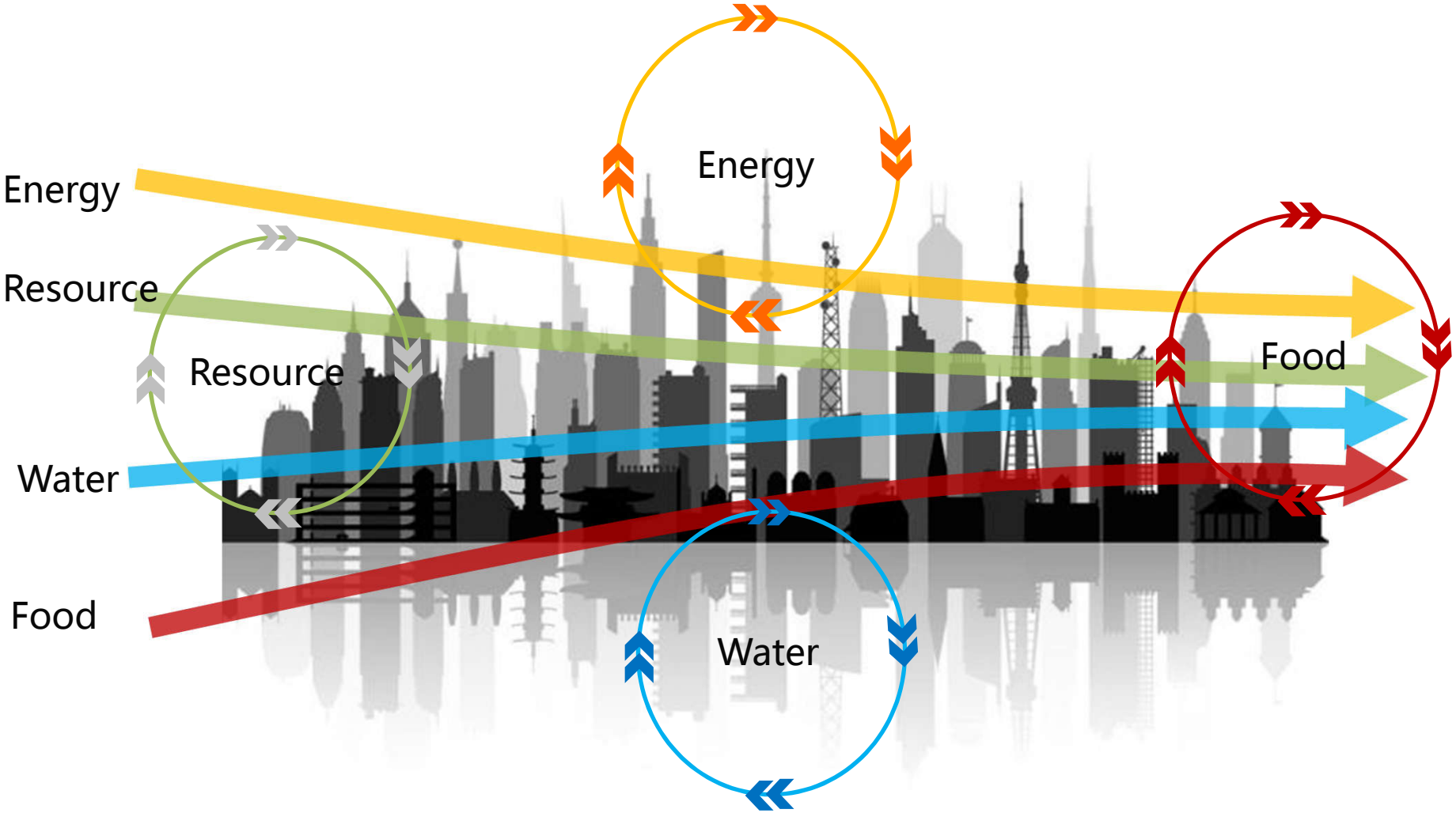
Look Out for the Future!

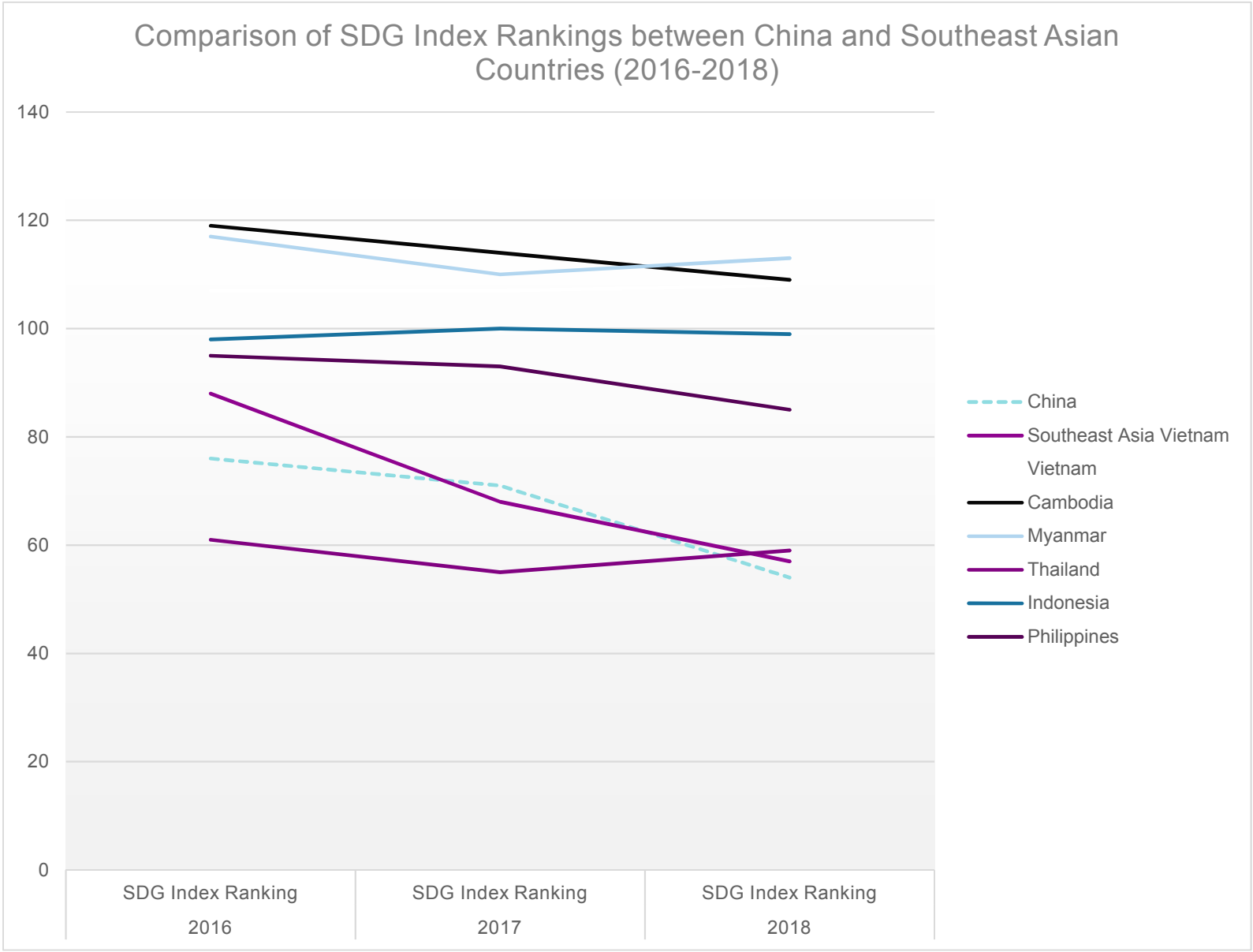
International Water Governance

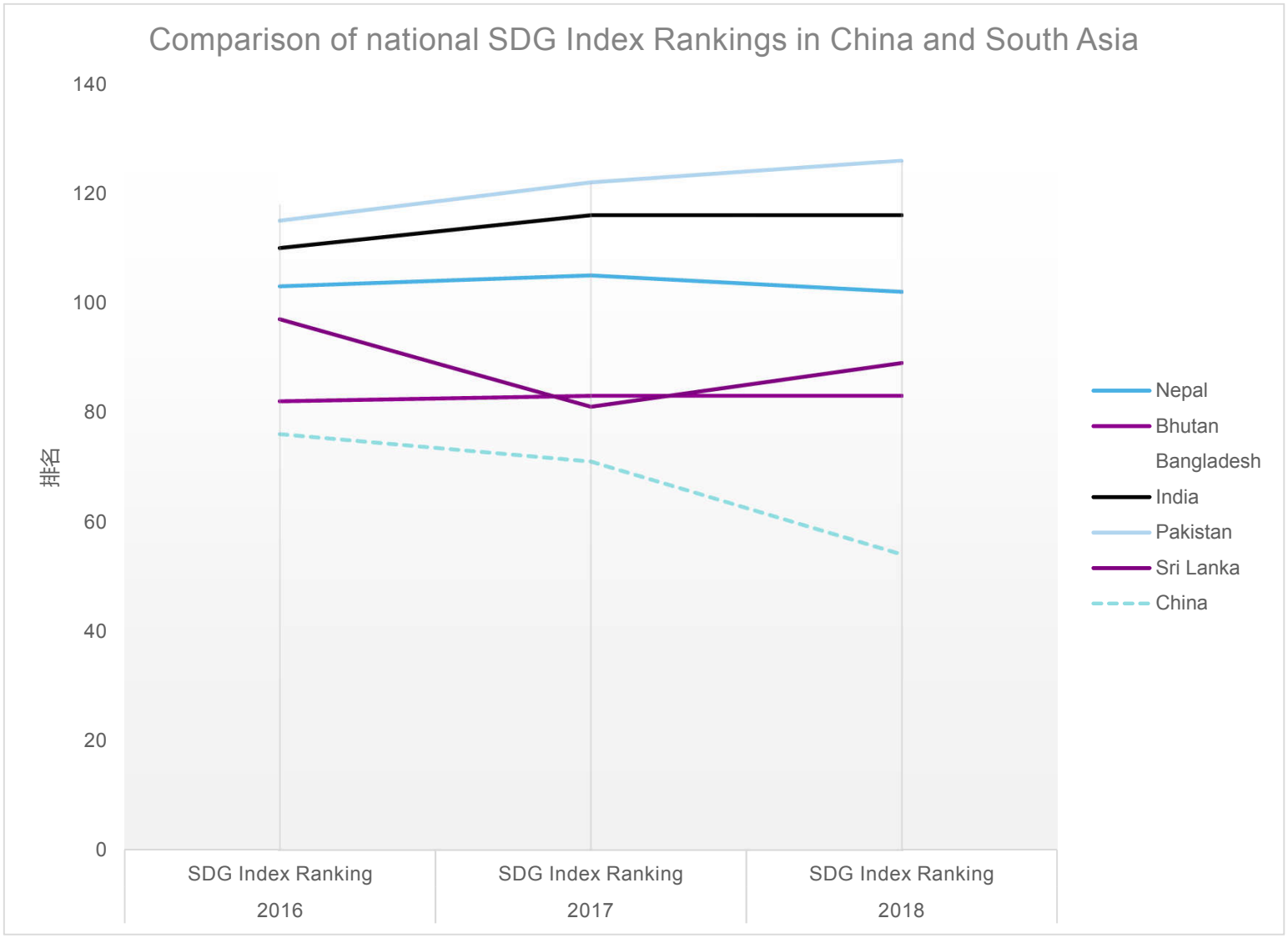
- Hope for the Future?
  - Signs of increasing transparency
    - Increased hydrological data-sharing
    - Meetings of experts from both India and China
  - Water resource management carries over into other sectors.
    - “crucial” to large-scale, sustained socioeconomic development in the region
  - Positive Sino-Asian countries’ water relations could create more trust for non-water issues

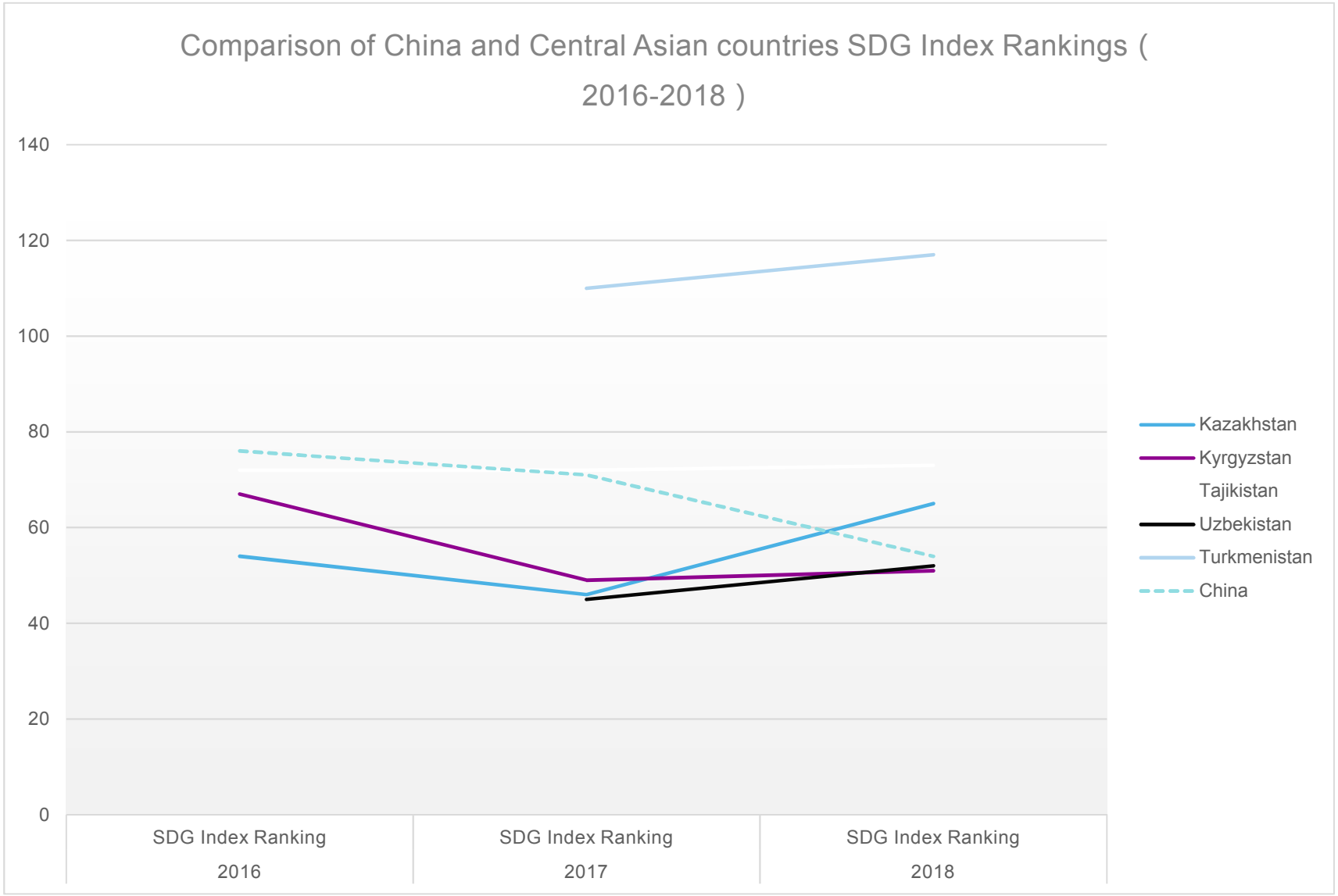
Green Development Eco-Civilization

Traditional Growth Route




Comparison of SDG Index Rankings between China and Southeast Asian Countries (2016-2018)
140
120
100
80
60
40
20
0
SDG Index Ranking 2016
SDG Index Ranking 2017
SDG Index Ranking 2018
China
Southeast Asia Vietnam
Vietnam
Cambodia
Myanmar
Thailand
Indonesia
Philippines


Comparison of national SDG Index Rankings in China and South Asia
140
120
100
80
60
40
20
0
排名
SDG Index Ranking 2016
SDG Index Ranking 2017
SDG Index Ranking 2018
Nepal
Bhutan
Bangladesh
India
Pakistan
Sri Lanka
China


Comparison of China and Central Asian countries SDG Index Rankings (2016-2018)
140
120
100
80
60
40
20
0
SDG Index Ranking 2016
SDG Index Ranking 2017
SDG Index Ranking 2018
Kazakhstan
Kyrgyzstan
Tajikistan
Uzbekistan
Turkmenistan
China

China's Strategy of Future Cooperation

- Strengthen coordination and consultation with governments under the principle of mutual benefit and win-win;
- Design Hydro-diplomatic Strategy
- Chinese government should increase the support for water-energy-food cooperation
- Strengthen the information collection, establish and improve the water governance information system;
- Perfect the relevant laws and regulations of overseas investment system as soon as possible.

	Commission	Information sharing
Bangladesh	None	Provision of general hydrological data and hydrological data in flood season for Yalu Zangbu River
India	Joint steering commission is established	Provision of hydrological data in flood season of Yalu Zangbu River and Langqin Zangbu River
Kazakhstan	Joint steering commission and experts groups are established	Provision of general discharge data and data when warning level has been exceeded
Mongolia	Joint steering commission is established	Share hydrological data when warning level has been exceeded
North Korea	None	Provide hydrological data on the Yalu and Tumen Rivers
Russia	Joint steering commission and experts groups are established	Share hydrological data for the Amur River in flood season
Vietnam	None	Exchange of hydrological data

	Mekong with Lower mekong	Ili with Kazakhstan
Actors	States; NGOs, INGOs	NGOs; IGOs; states
Perception/values	Availability prioritised	Ecology prioritised
Management focuses	Human disaster; resource use, integrative water management	Human needs; ecology
Reliance on Water-energy nexus	Both sides strongly rely on water's nexus uses	Both sides have shown weak reliance on water's nexus uses

New Trend of Establishing Eco-Civilization: Connective Governance of the Water-Energy-Food

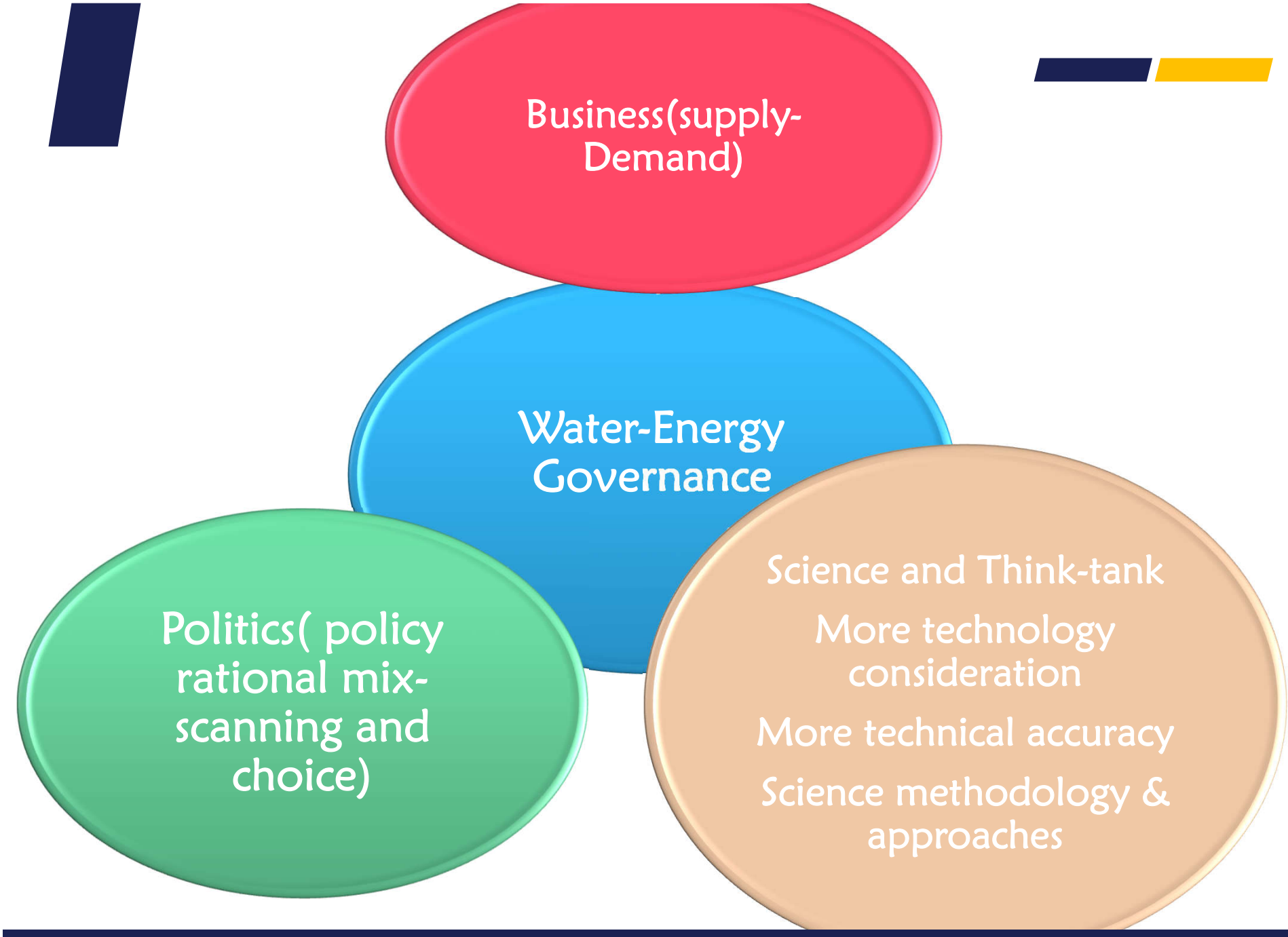
Thirdly, the governance of water-energy-food nexus must be a process that contains participati of multipule interest groups.

✳Goverment：In consideration of the connectivity of water-energy-food system, it's necessary to plan through legal or institutional tools, using a holistic or crossover way, and combining with a supportive policy. Especially focus on inter-province and inter-city coordination and cooperation based on a good basin governance.

✳Market：Coupling of water quotas and carbon quotas, to bring regional grain production chain into the system, and to accomplish low-cost resource allocation which rely on the water rights market and the carbon market.

✳Society：The role of social supervision and the promotion of information disclosure. Data like current water pollution, carbon emissions, soil pollution and others still lack in transparency.

✳Academia：Provide intellectual support, especially forward-looking policy innovations, technical support, data collaboration and scientific assessment.


Business(supply-Demand)
Water-Energy Governance
Politics(policy rational mix-scanning and choice)
Science and Think-tank
More technology consideration
More technical accuracy
Science methodology & approaches

	Mekong with Lower mekong	Ili with Kazakhstan
Actors	States; NGOs, INGOs	NGOs; IGOs; states
Perception/values	Availability prioritised	Ecology prioritised
Management focuses	Human disaster; resource use, integrative water management	Human needs; ecology
Reliance on Water-energy nexus	Both sides strongly rely on water's nexus uses	Both sides have shown weak reliance on water's nexus uses

Thanks for Attending

Prof. YU Hongyuan
yuhongyua@siis.org.cn
Shanghai Institutes for International Studies