Water Demand for Energy Transition under Climate Change Mitigation Targets in China

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Introduction

- **China's pledge for climate change mitigation**
  - Paris Agreement; NDC
  - CO_2 emission peak by 2030; Carbon neutral by 2060
- **Both synergies and trade-offs are obvious between CC mitigation and water resources**
  - Shortage of water resources
  - Water efficiency
- **Would water resource be barrier to CC mitigation in energy system?**
  - How does the CC mitigation in energy system affect the water demand? Would it increase the water stress?
  - How does change in energy transition pathways under different the water demand mitigation stringency?
  - What are the key factors in the energy transition that affect water use in the energy sector?

Scenario setting

	Description
BaU	Existing climate and energy polies achieved; GDP growth rapidly; Low-carbon technologies in building and transport sectors develop fast; High consumption pattern; Treatment after pollution way.
2C	Globally mitigation to achieve 2℃ target; CO_2 emissions budget between 2011-2050 for China ≤ 300 Gt ; Low-carbon development with consideration of energy conservation, renewable energy development and the potential of nuclear power.
1.5C	Globally mitigation to achieve 1.5℃ target; CO_2 emissions budget between 2011-2050 for China ≤ 250 Gt ; Further mitigation based on the 2C scenario; Rapid development of CCS applied in both power generation and industry sector.
2C-LW	Further water saving technologies applied, based on the 2C scenario.
1.5C-LW	Further water saving technologies applied, based on the 1.5C scenario.

Results

- **Energy and CO_2 emissions Pathway**

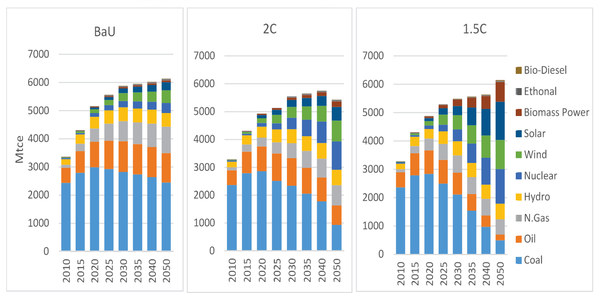


Figure 1 Primary energy demand

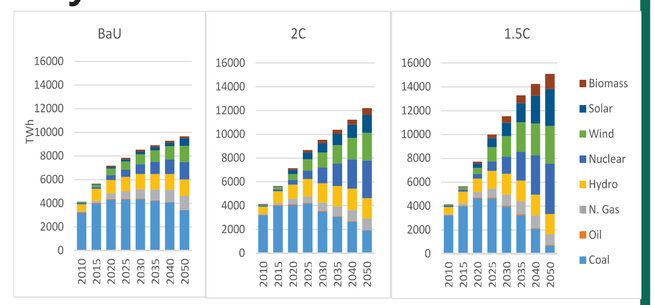
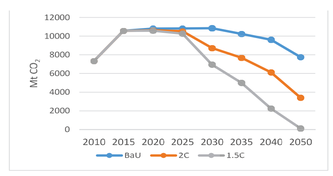


Figure 2 Power Generation



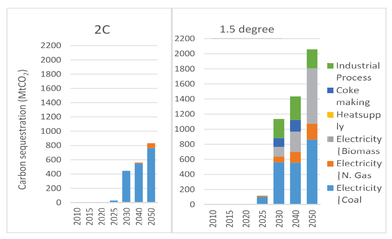


Figure 3 CO_2 emissions and CCS

- Primary energy demand would keep increasing in the coming decades
- Fast electrification and the development of non-fossil fuel energy are the main measures for CC mitigation
- CO_2 emissions peak would be advanced from around 2030 in baseline scenario to between 2020 and 2025 under the mitigation scenarios
- CO_2 emissions are projected to achieve near zero-emission under the 1.5C scenario around 2050, with rapid development of CCS technologies

- **Water for energy**
  - Water demand for energy sector would continue to increase, putting continuous stress on water resources
  - Water consumption of low-carbon energy technologies various a lot. Water constraint must be taken into consideration when making energy strategies
  - Key factors influence water efficiency in energy sector include inland nuclear power, biomass energy, and CCS etc.
  - The total amount control is the main constraint of water use in energy development. The impact of water cost on energy technology selection is not obvious

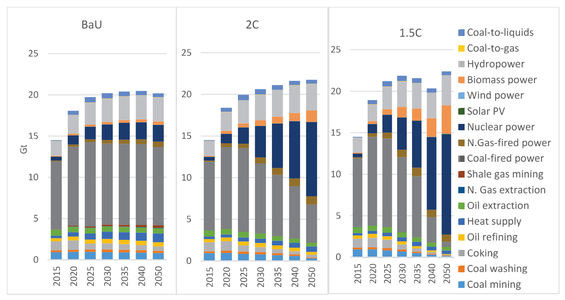


Figure 4 Water demand for energy sector

Findings and Discussions

- **Under the mitigation pathways supporting the Paris Agreement targets, the total energy demand would keep increasing**
  - There are feasible pathways to achieve both global and domestic carbon mitigation targets
  - The total energy consumption still needs some room for growth
  - Energy structure optimization, electrification in enduse sectors, and CCS technologies are the key measures for mitigation
- **Water resource stress of energy sector will continue in the coming decades in China. Application of water-saving technologies must be considered simultaneously with the energy transition**
  - Water consumption in the energy sector would continue to increase, with the total energy consumption growing
  - Low-carbon energy technologies have different patterns of water demand, making water resource a crucial constraint for technology choices in energy transition in China
  - Amount control of water resources requires effective water-saving technologies to be adopted during the process of energy transition
  - Under two low water demand mitigation scenarios (2C-LW and 1.5C-LW scenarios), which considering water-saving measures for the key factors, the potential of water conservation in the energy sector under specific climate mitigation targets are discussed (see Figure 5)
- **Targeted water-saving technologies can significantly alleviate the water stress in energy sector for long-term, while the short-term stress is still inevitable**
  - Some mitigation measures will reduce the water efficiency of the energy sector, which is not conducive to water conservation in the energy sector.
  - Key factors influence water efficiency in energy sector include inland nuclear power, biomass energy, and CCS etc.
  - The water-saving measures aimed at these key factors, such as air cooling in nuclear power generation process, can significantly reduce long-term water demand in the energy sector
  - The short-term water stress in the energy sector could not be avoided. Because that such water-saving effect needs to occur with the process of energy transition
- **There are feasible pathways to meet both the realization of the energy transition under the goals of the Paris Agreement, and gradually reduce the pressure on water resources at the same time for China**
  - However, as most water-saving measures will bring about a decline in energy efficiency, it is proposed to consider the trade-offs between energy and water while making relevant climate/energy policies or decisions

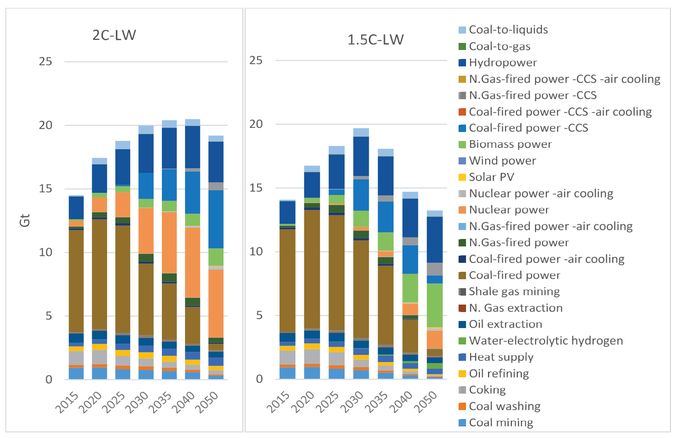


Figure 5 Water demand for energy sector with water saving technologies