



# Energy resilience and the water-energy nexus

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Asia Clean Energy Forum, Manila, 7 June 2017

- Energy security has been a core mission of the IEA since its founding in 1974.
- Resilience: the capacity of the energy system to cope with a hazardous event or trend, responding in ways that maintain its essential function and structure
- Climate change affects all components of the energy system
  - *Primary energy supply*
  - *Energy transformation*
  - *Transportation, transmission, distribution*
  - *Energy demand*

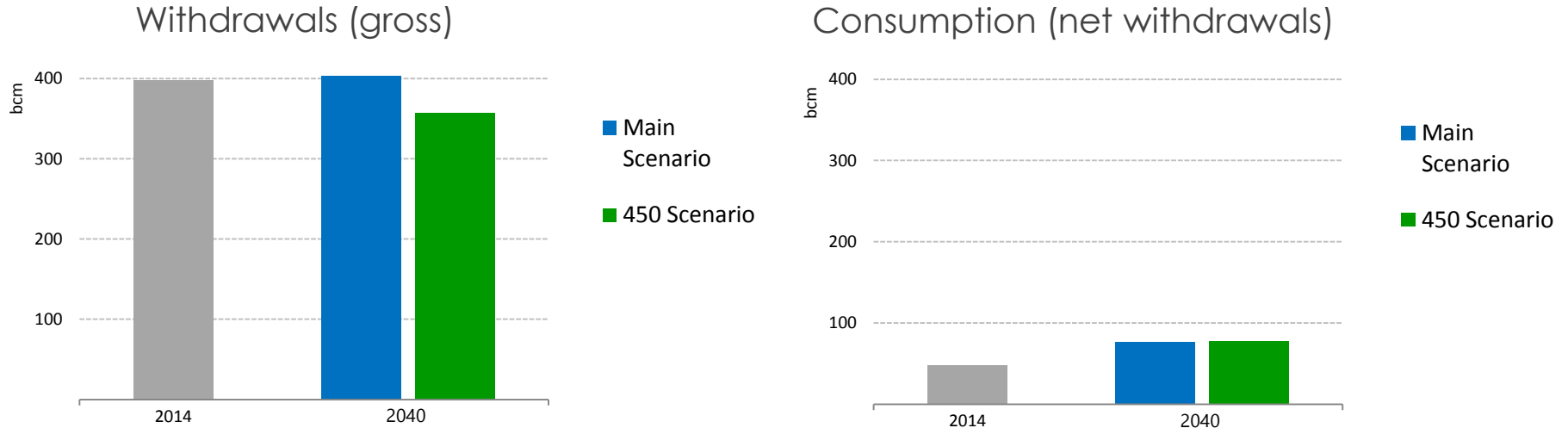


- Solar PV and wind can reduce water needs; CCS, concentrating solar power, nuclear, and biofuels can exacerbate water stress
- Hydropower is vulnerable to water shortages; but serves as energy storage
- Synergies between actions that meet both low-carbon and resilience objectives should be emphasised:
  - energy efficiency
  - distributed renewable generation
  - energy storage



# Different low-carbon technologies have different water needs

## Global water requirements for the energy sector by scenario

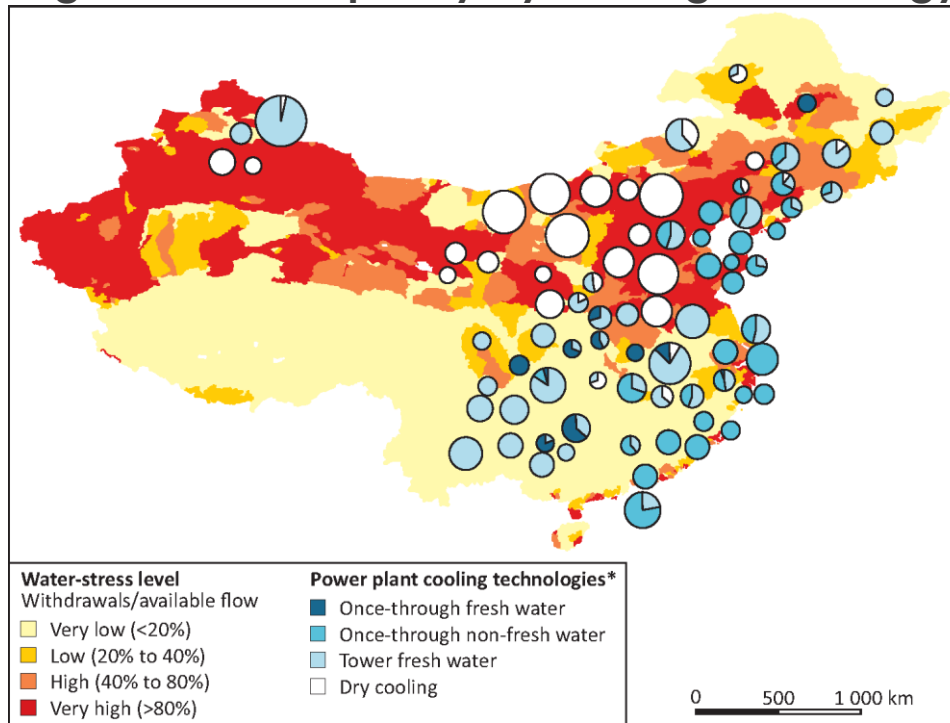


Source: IEA World Energy Outlook, 2016

**The shifts away from coal & natural gas in the power sector lowers withdrawals in the 450; but increased shares of nuclear, CCS & CSP increase consumption**

# Mapping future coal power plants under water constraints

## Installed coal-fired power generation capacity by cooling technology in China in 2040



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Source: IEA World Energy Outlook, 2015

**Future coal-fired power generation sites will consider water as a factor beyond coal transportation cost and electricity transmission cost to load centres alone**

# Variable renewables can enhance energy resilience

## Benefits

- **Diversification**
  - Balanced generation portfolio
  - Diversify fuel mix
- **Domestic supply**
  - Reduce import bills and lower fossil fuel price risks
- **Environment**
  - Greenhouse gas and local pollution reduction

## Risks

- **Variable and uncertain**
  - Outputs depend on weather and climate



## System integration options



Grid



Generation



Storage



Demand shaping

**More clean, secure and resilient system**

- In addition to the need to decarbonise, the energy sector must also build resilience to climate change and other risks
- Depending on the mix of technologies and fuels employed, the low carbon transition can build resilience in some ways, but create new risks in others
  - Solar PV and wind can reduce energy water needs; CCS, biofuels, CSP can increase water stress
- Integrated planning can help achieve multiple policy objectives – including decarbonisation, resilience-building, and smarter water use – while avoiding unintended negative outcomes
- Variable renewables can enhance energy system resilience, but successful integration of high shares requires improvements in system planning, operation and market design

