Energy resilience and the water-energy nexus

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Energy security and resilience in the face of climate change

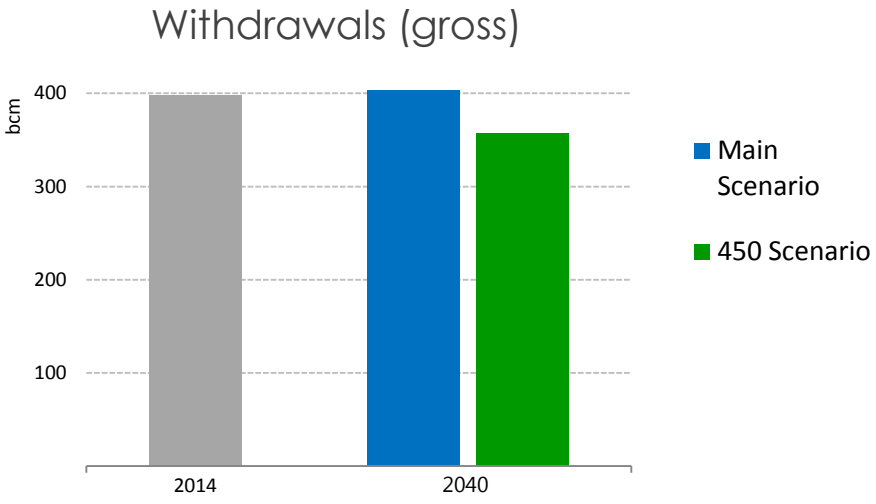
- Energy security has been a core mission of the IEA since its founding in 1974.
- Resilience: the capacity of the energy system to cope with a hazardous event or trend, responding in ways that maintain its essential function and structure
- Climate change affects all components of the energy system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

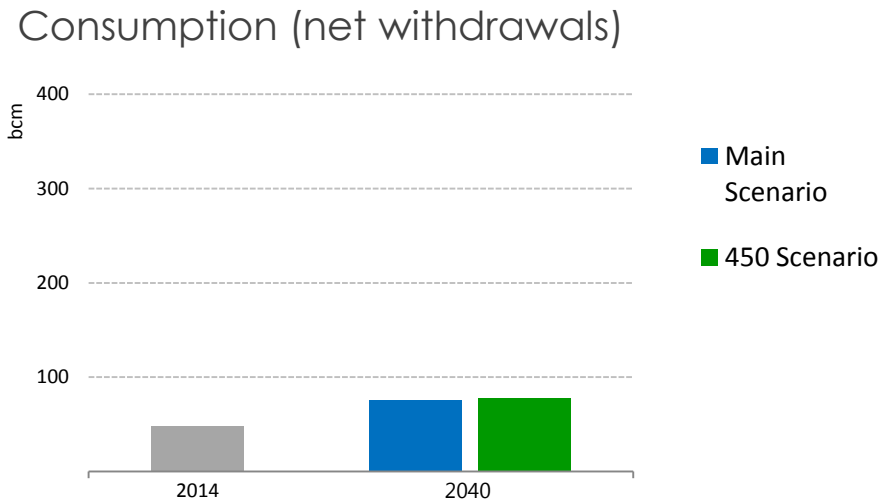
The choice of low-carbon technologies and fuels affects energy resilience

- 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



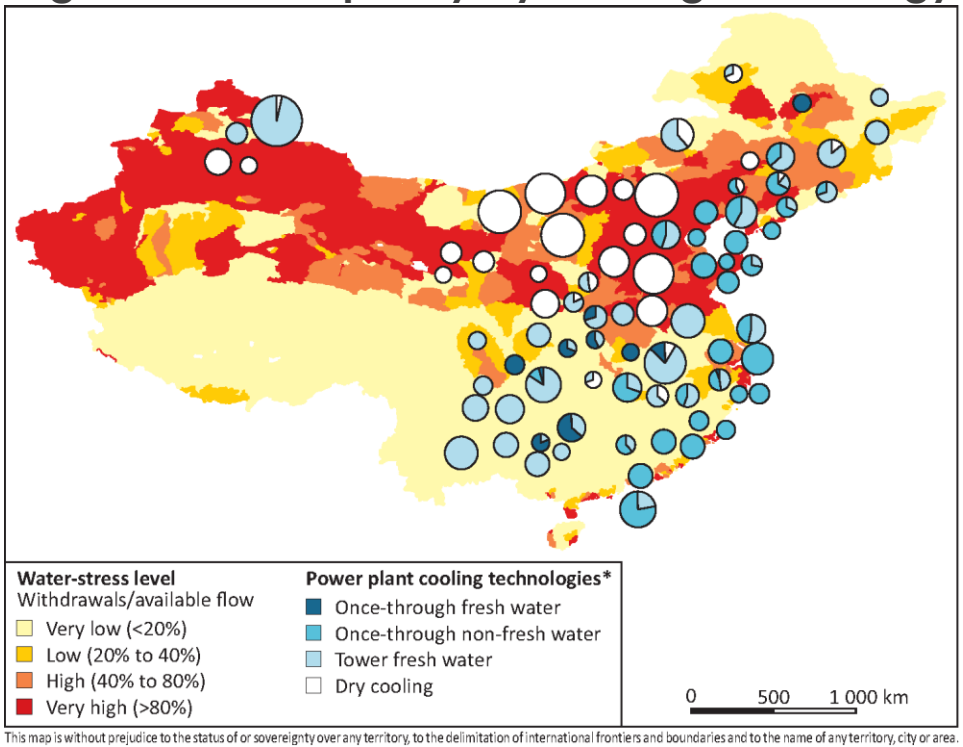


Source: IEA World Energy Outlook, 2016

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



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

Conclusions

- 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