The Energy Water Nexus

- as seen by the World Energy Council

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WORLD ENERGY COUNCIL
CONSEIL MONDIAL DE L'ÉNERGIE
For sustainable energy.

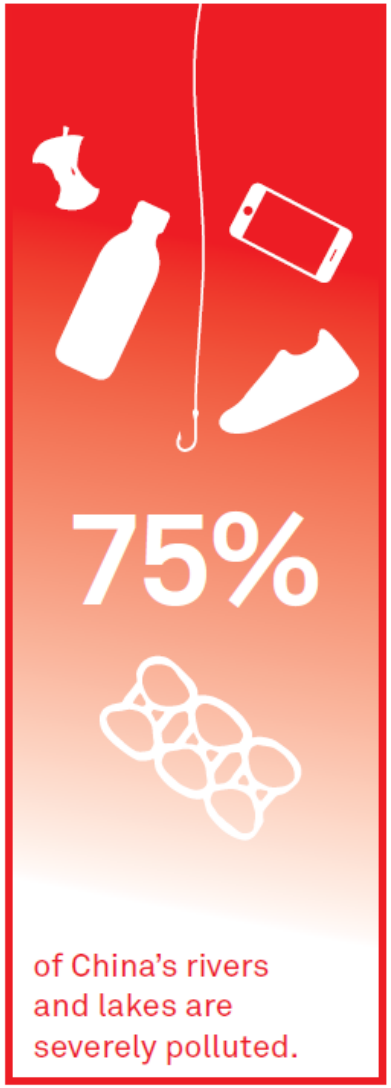
World Energy Council – who we are

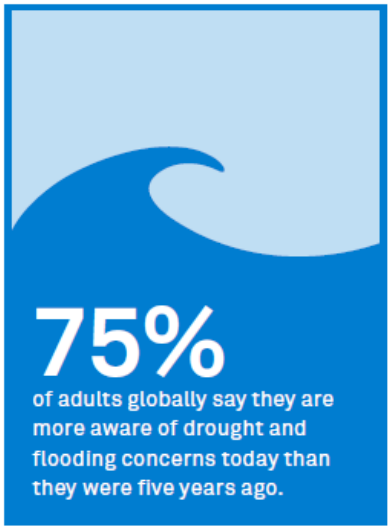
‘The world energy leaders’ network.’

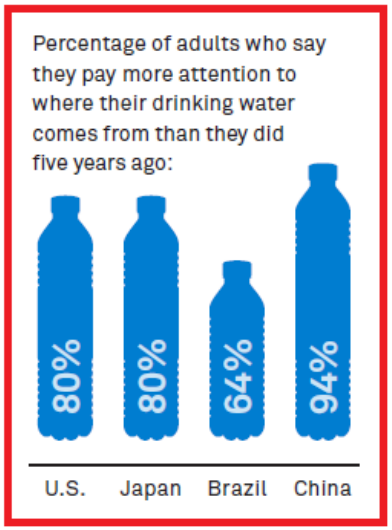
- Truly global
- Inclusive and impartial
- Committed to our sustainable energy future since 1923

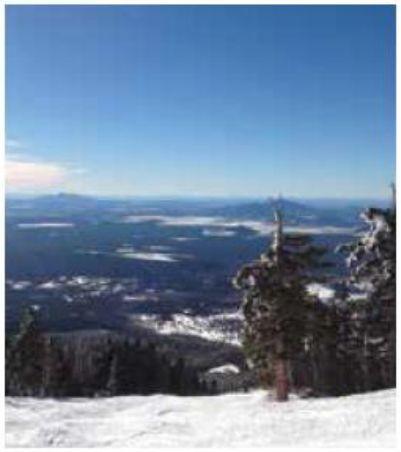
  - 93 national committees chaired by energy ministers, leading CEOs and practitioners
  - Represents over 3000 government, private sector and experts organisations
  - Flagship event: World Energy Congress, every three years, 2013 in Daegu, South Korea. Next Congress, 2016 in Istanbul, Turkey

Water trends ……







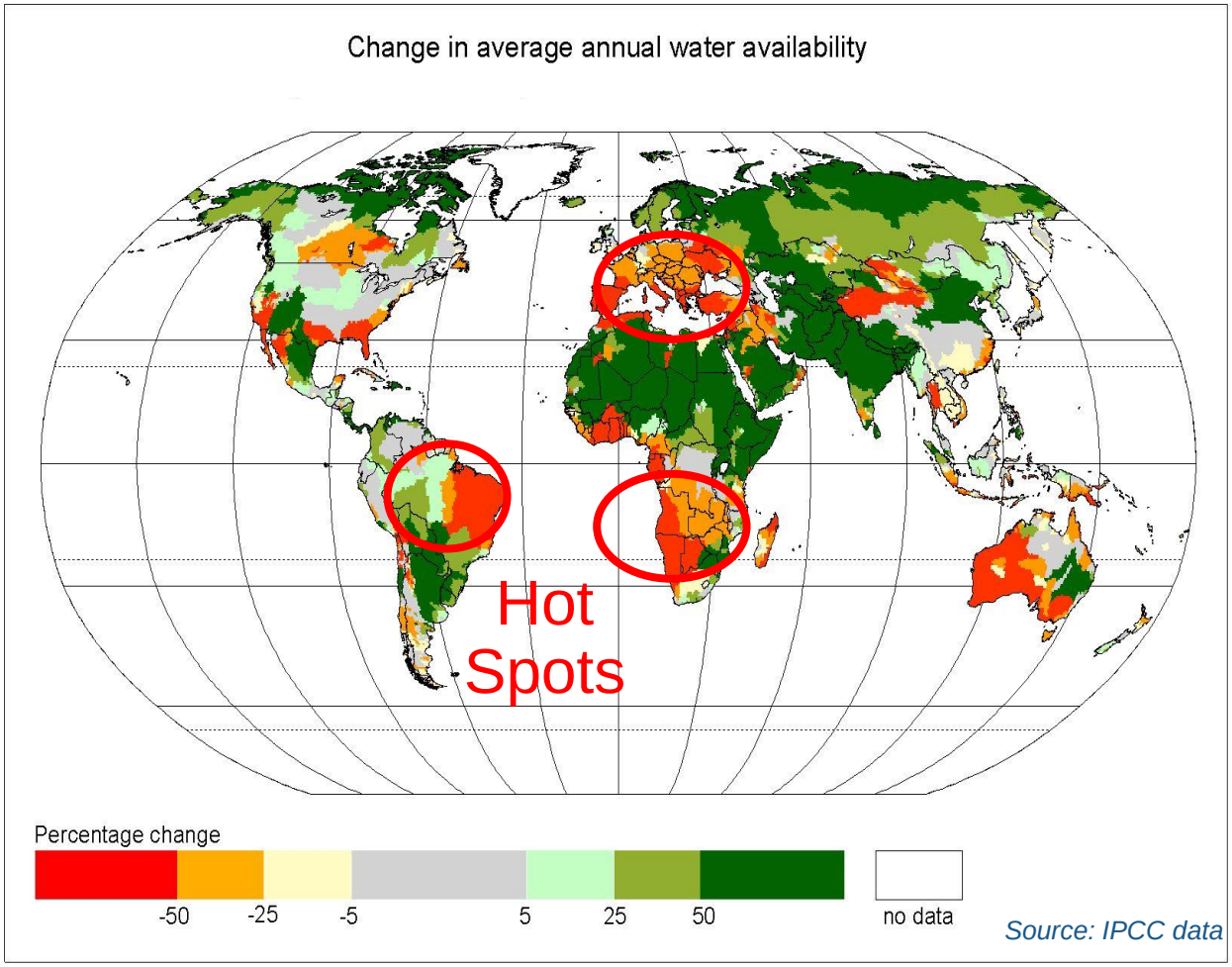


Skiing on Sewage

After decades of unpredictable ski seasons that lasted as little as four days, last January the Arizona Snowbowl started ensuring a reliable supply of snow by using water recycled from sewage. It was the first ski area to make snow entirely from treated effluent, but as facilities across the country confront drought and future water restrictions, the practice could become more widespread throughout the $12.2 billion global skiing industry.

Source: Ford, 2014 Trends

Access to fresh water is becoming more difficult



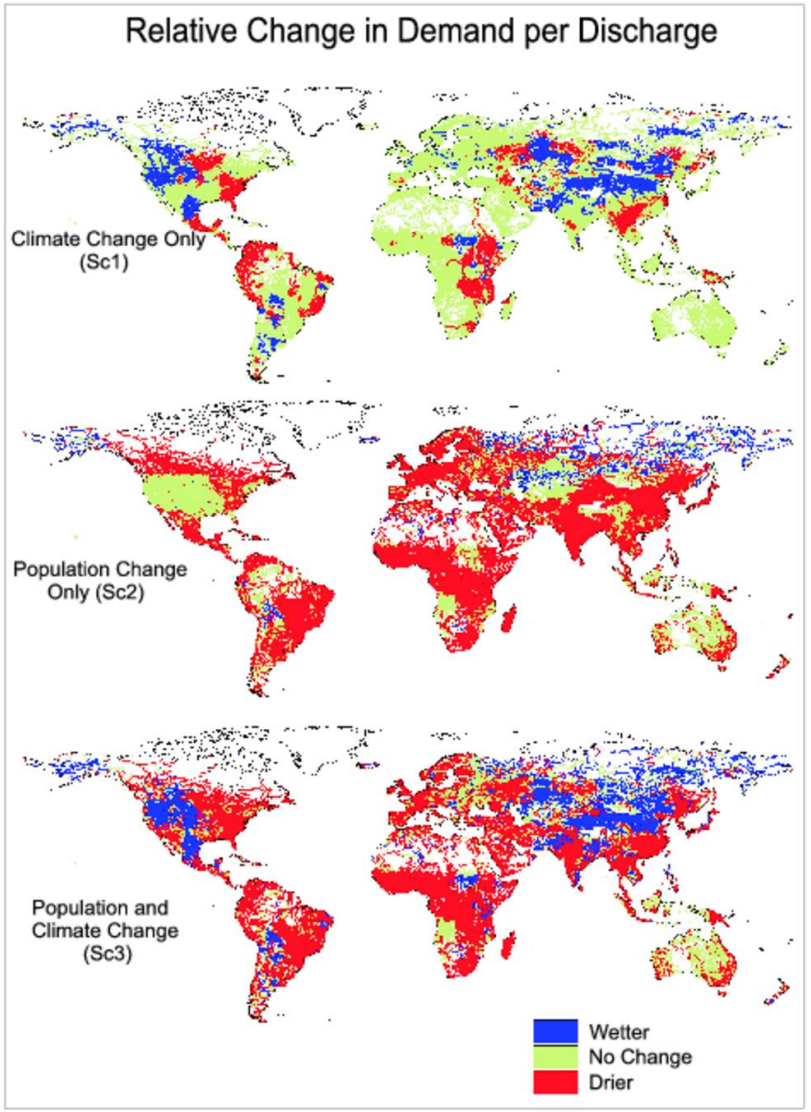
Countries that will be impacted most include

- US
- Canada
- Brazil
- EU countries
- ME countries
- Nigeria
- Gabon
- China
- Australia

By 2025, two thirds of the world's population will live in conditions of "water stress" adding significant pressure to the water available for industry (22% global water use)

Water stress changes to 2025

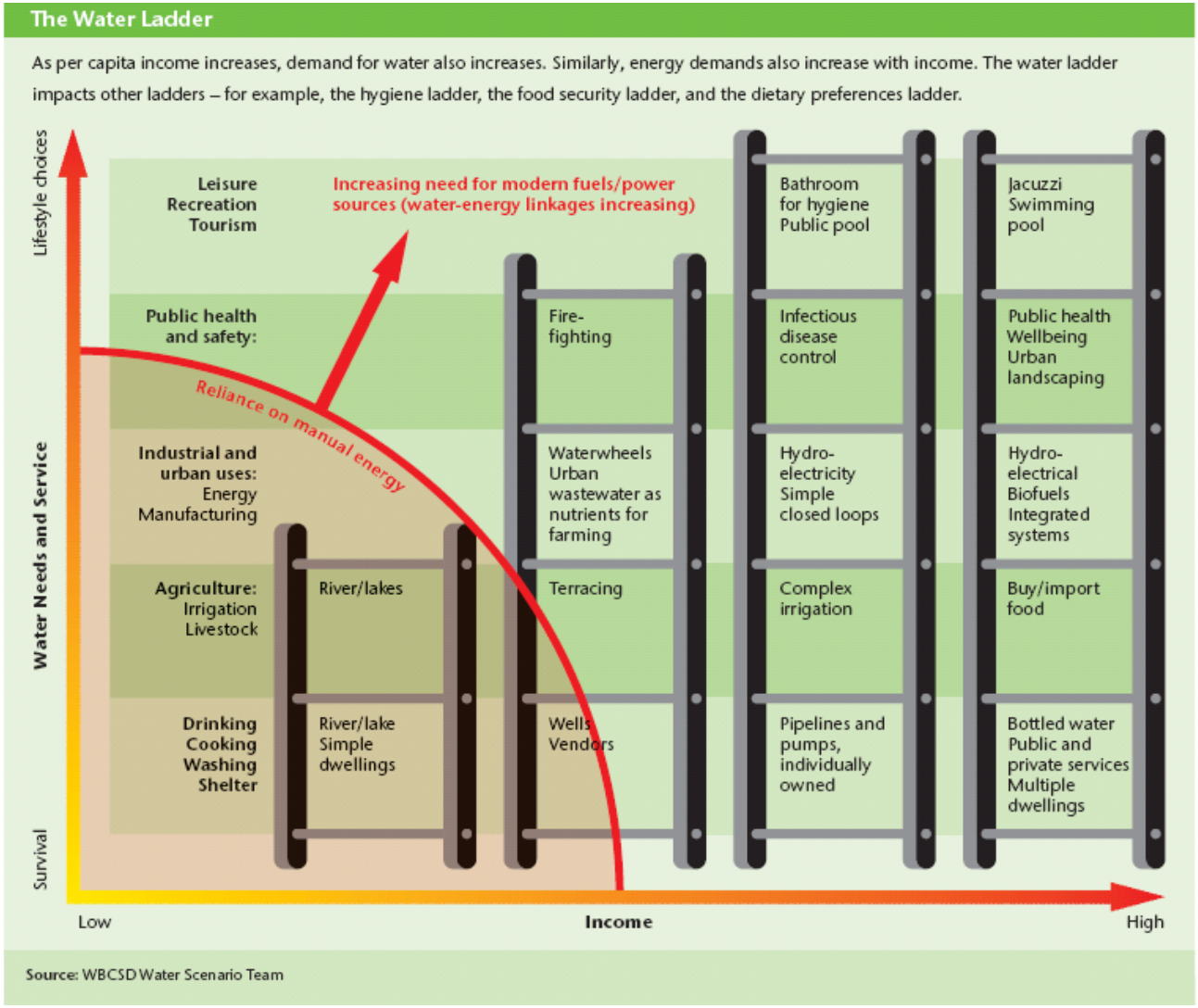
- 80% of future stress from population & development, not climate change!
- Correct Priorities? (e.g. 85% US global change research funding to climate and carbon)



UNH

Vörösmarty et al. 2000

The water ladder

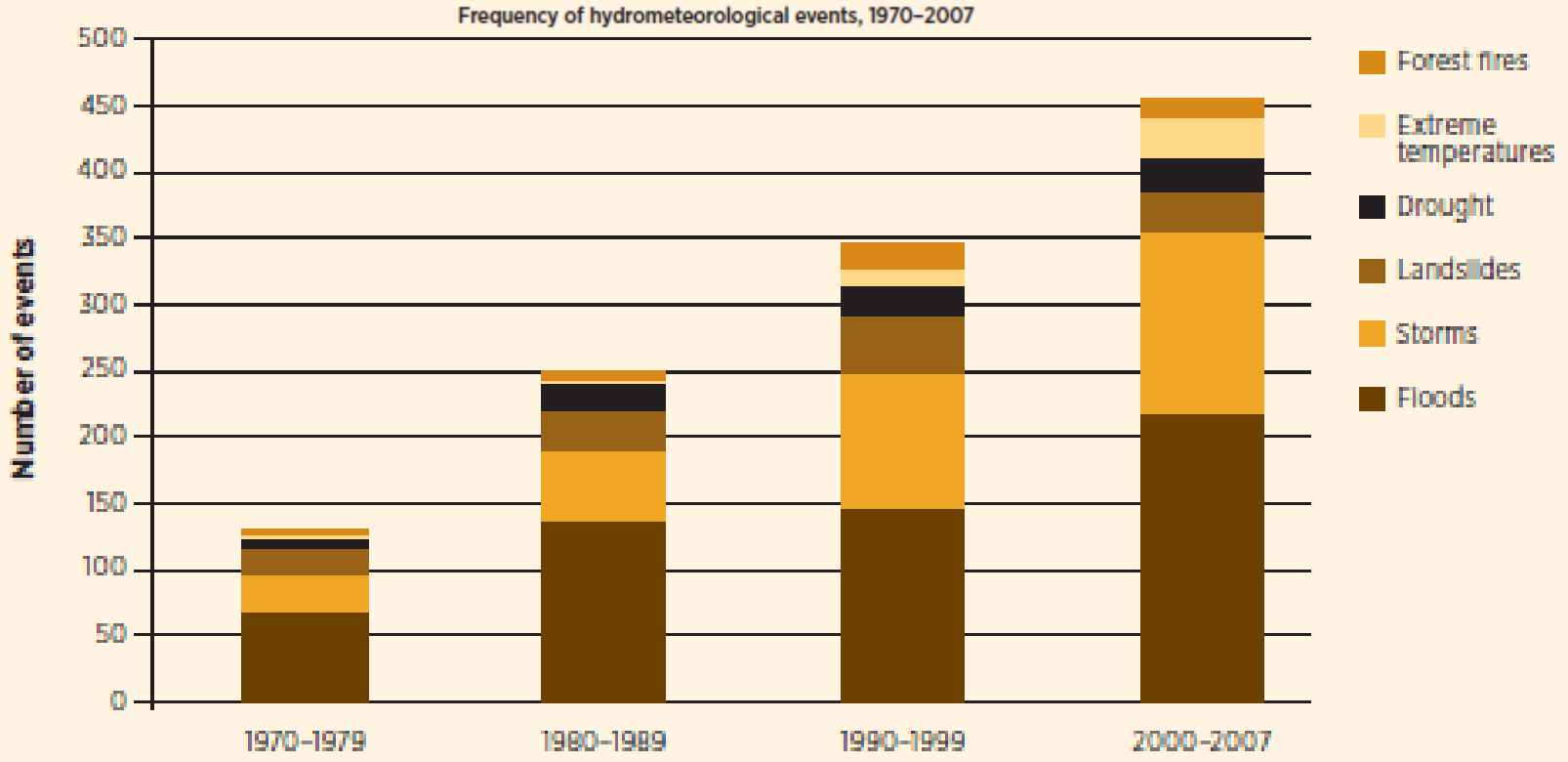


Impact and uncertainty set to increase

- Global water withdrawals for energy production in 2010 were estimated at 583 billion cubic metres (bcm), or some 15% of the world's total water withdrawals.
- According to WEC scenarios, total primary energy will increase between 30 and 60%, at the same time, extreme events, droughts and floods will also increase.
- Globally, average electricity generation per capita is projected to almost double by 2050. The fuel mix used to meet the rising energy demand has a direct impact on water resources.
- A more water-constrained future, as population and the global economy grow and climate change looms, will impact energy sector reliability and costs

Impact and uncertainty set to increase

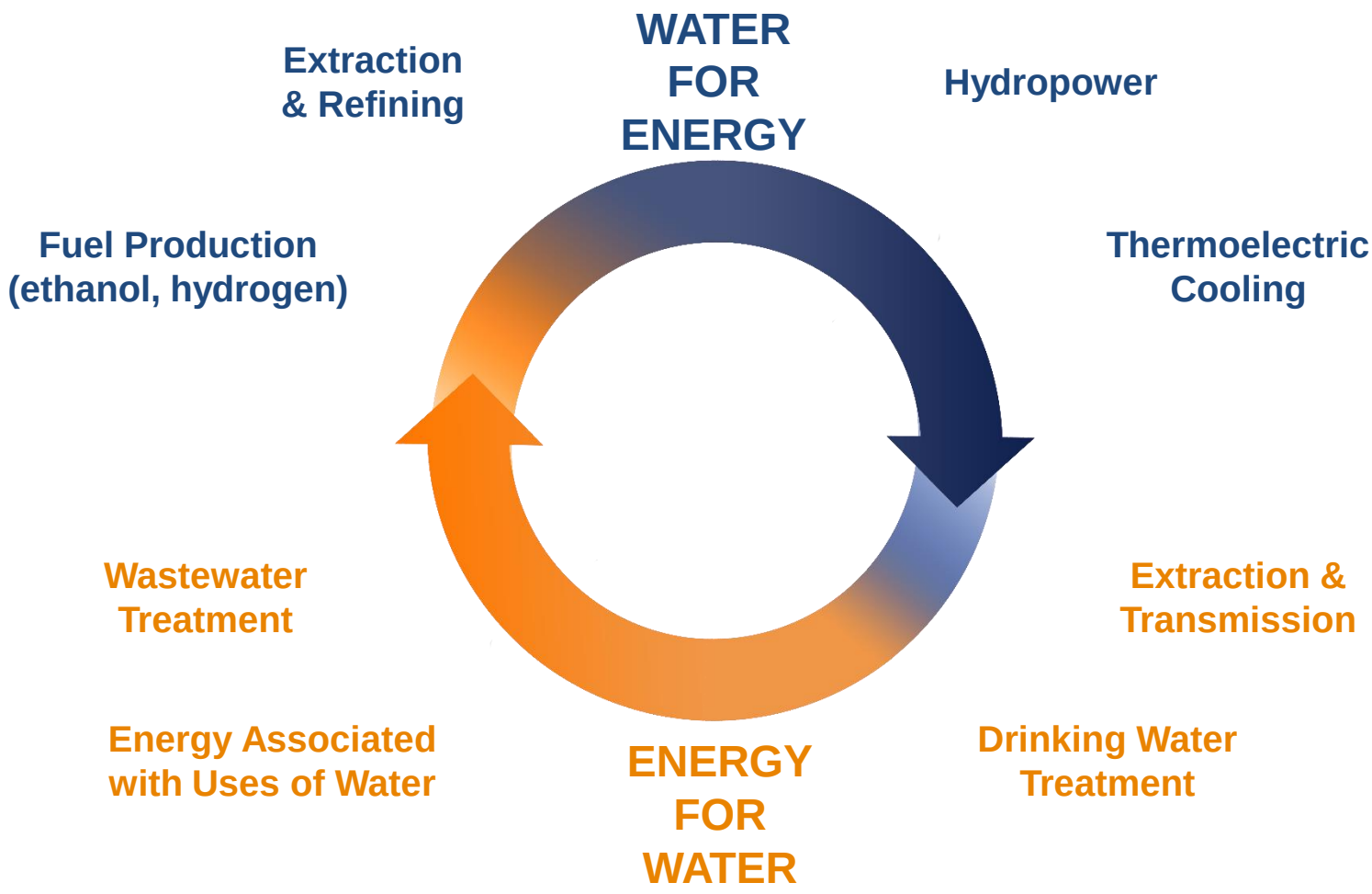
Most Climate Change Related Risks – urban heat waves, melting snowpack, longer droughts, increased wildfires, drying reservoirs, rising sea levels, desiccating soils - involve water



Source: UNEP (2010a, p. 40, with statistics from the CEPAL STAT database [http://www.pnuma.org/geo/geoalc3/ing/graficosEn.php]).

World Energy Issues Monitor 2013

Interdependence of Water and Energy

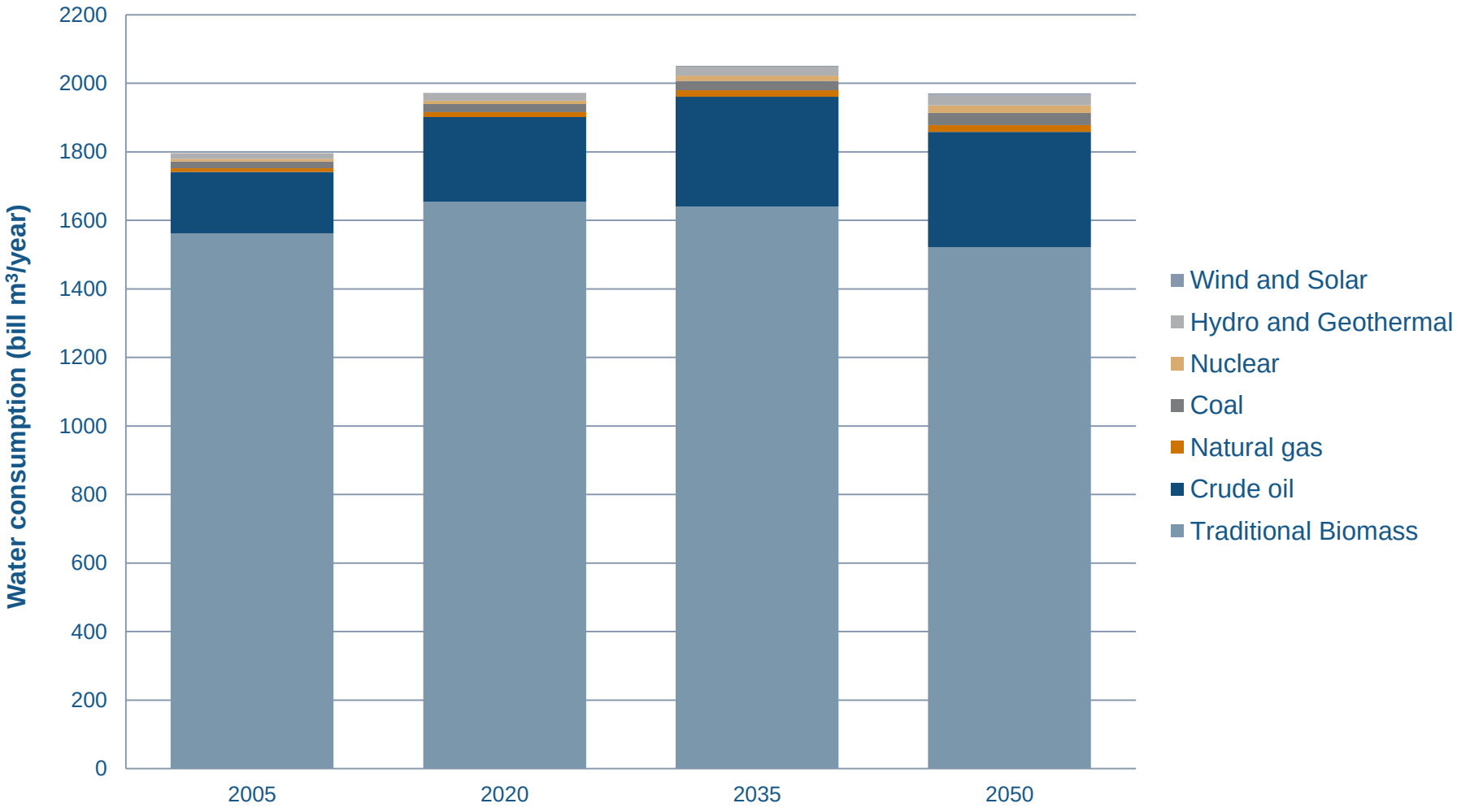


- The water energy nexus is an accelerating vicious circle driven by increasing energy for water use and increasing energy for water needs.

Source: Water for Energy, WEC, 2010

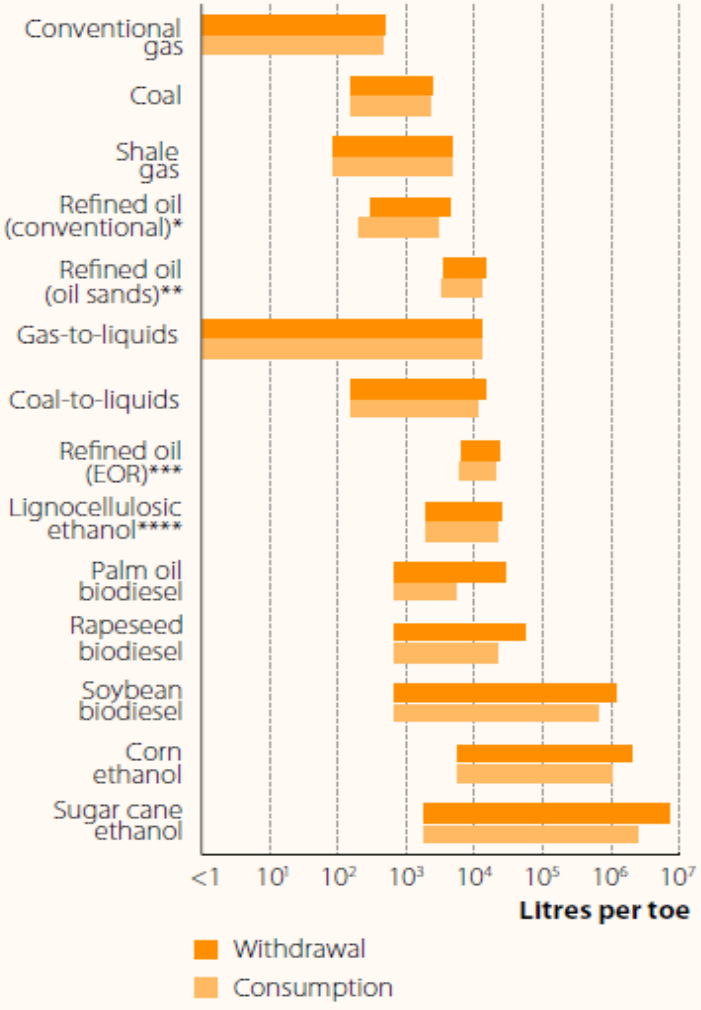
Increased need for energy = increased need for water

Water for Energy consumption per fuel type



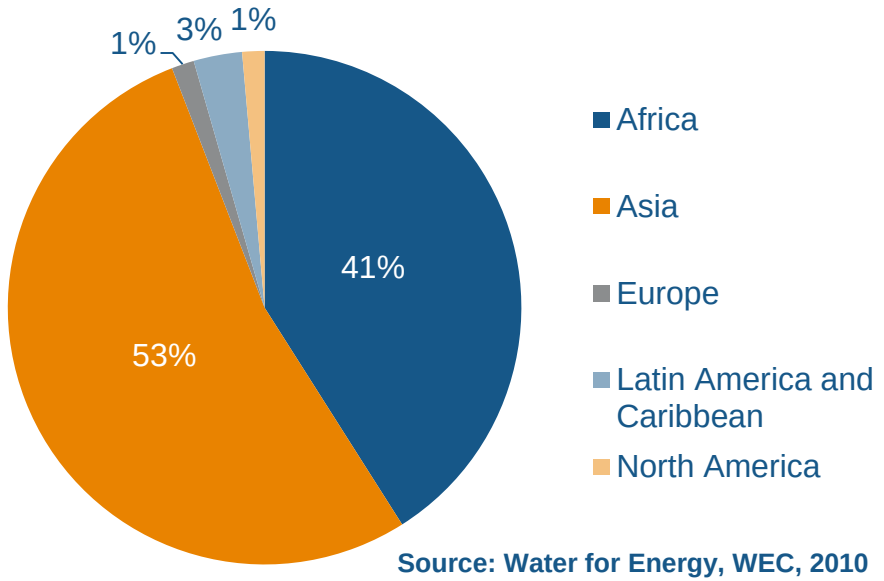
Source: Water for Energy, WEC, 2010

Water withdrawals and consumption vary for fuel production



- All types of energy production require water and an increase in energy supply will have a big effect on water resources.

Water consumption by traditional biomass by region



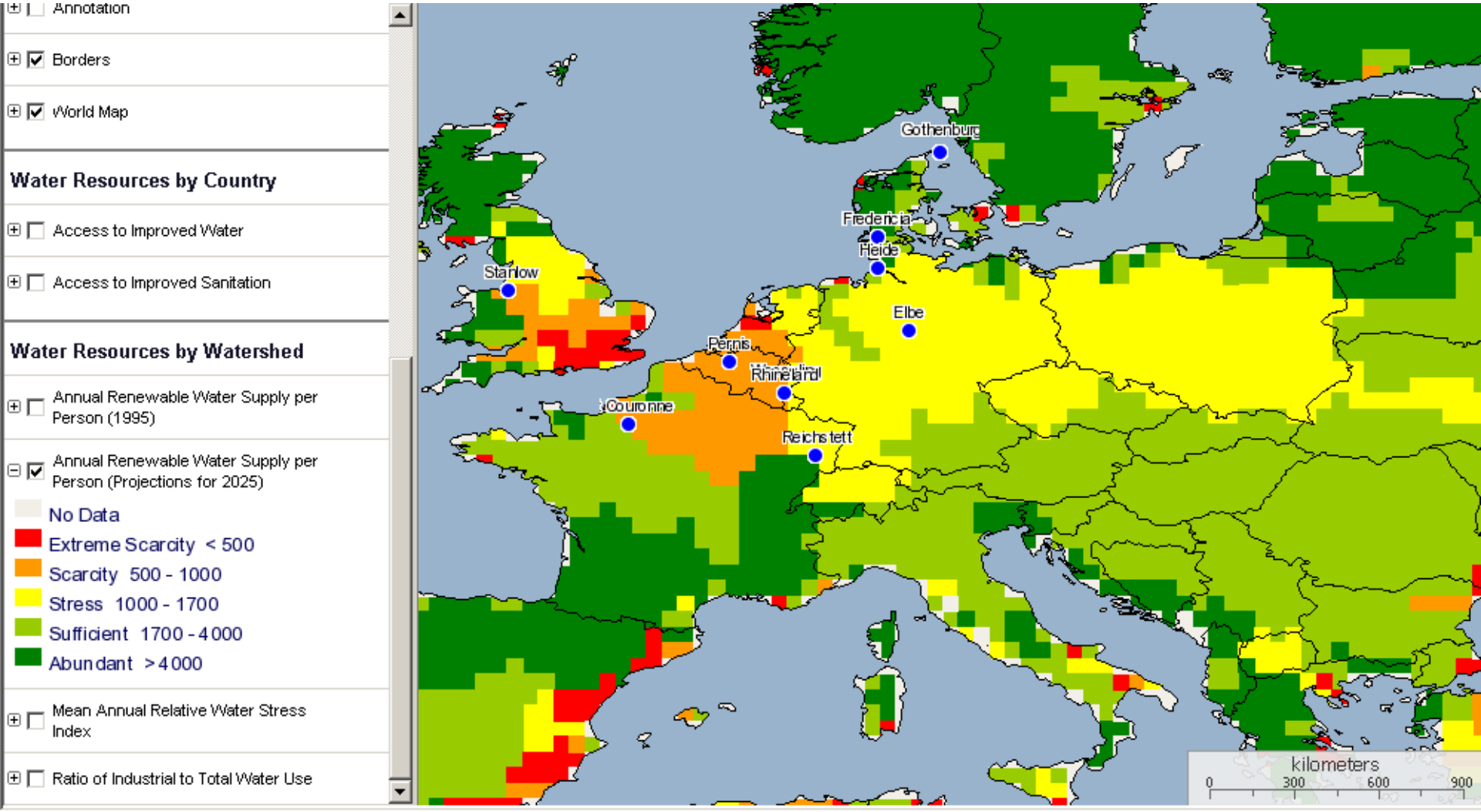
Source: Water for Energy, WEC, 2010

- Almost 90% of freshwater used to produce primary energy is for the production of biomass, which accounts for not even 10% of total primary energy production.

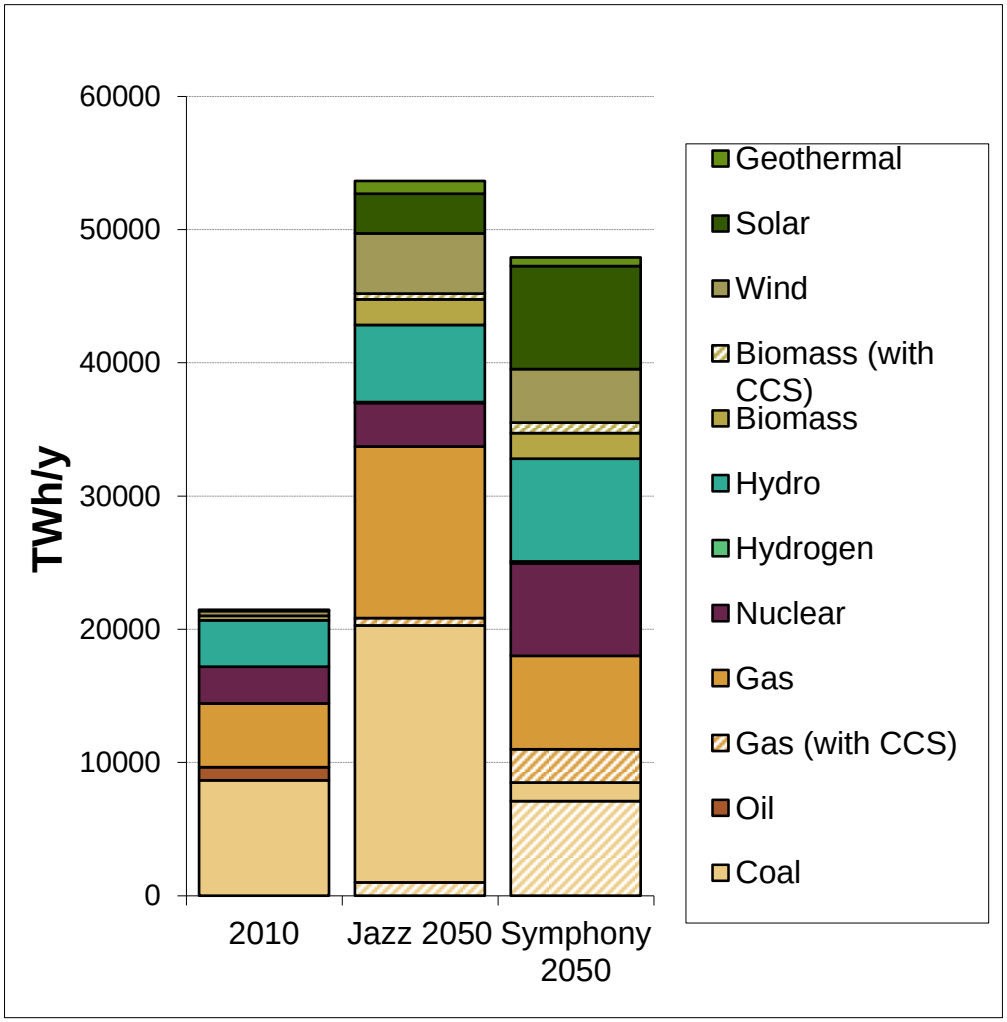
Source: UN Water Report 2014

Annual renewable water supply per person 2025

- Refineries operating in Europe (Projection2025)



Electricity production by primary energy



JAZZ:

- coal: expected to remain dominant
- gas: share increases (esp. N. America),
- nuclear: mainly non-OECD

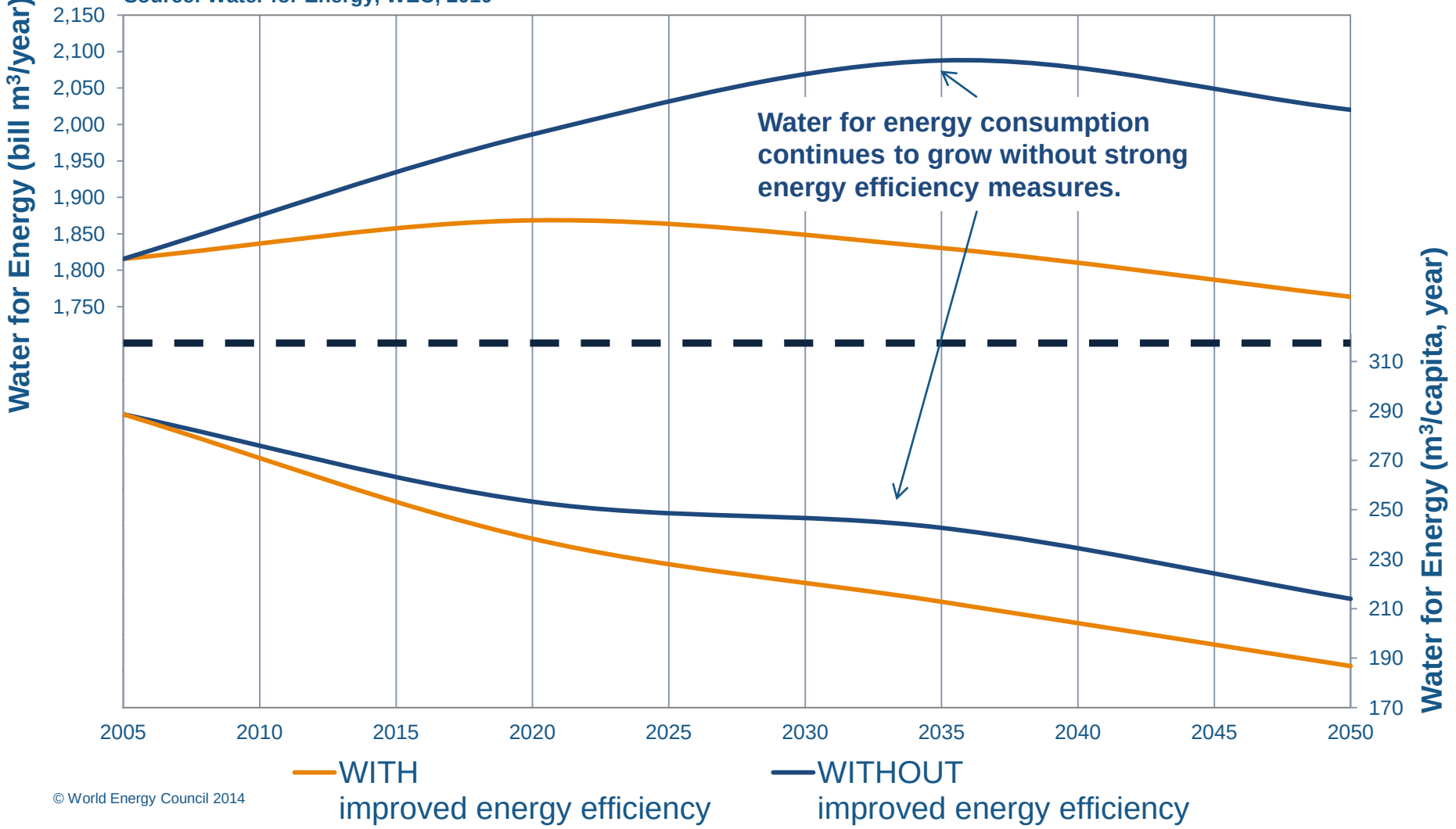
SYMPHONY:

- coal: share drops, CCS increasingly required
- nuclear: increasing; led by governments
- Renewables: stable & quicker transition

Improved energy efficiency = improved water consumption

Water for energy 2005-2050 with/without improved energy efficiency

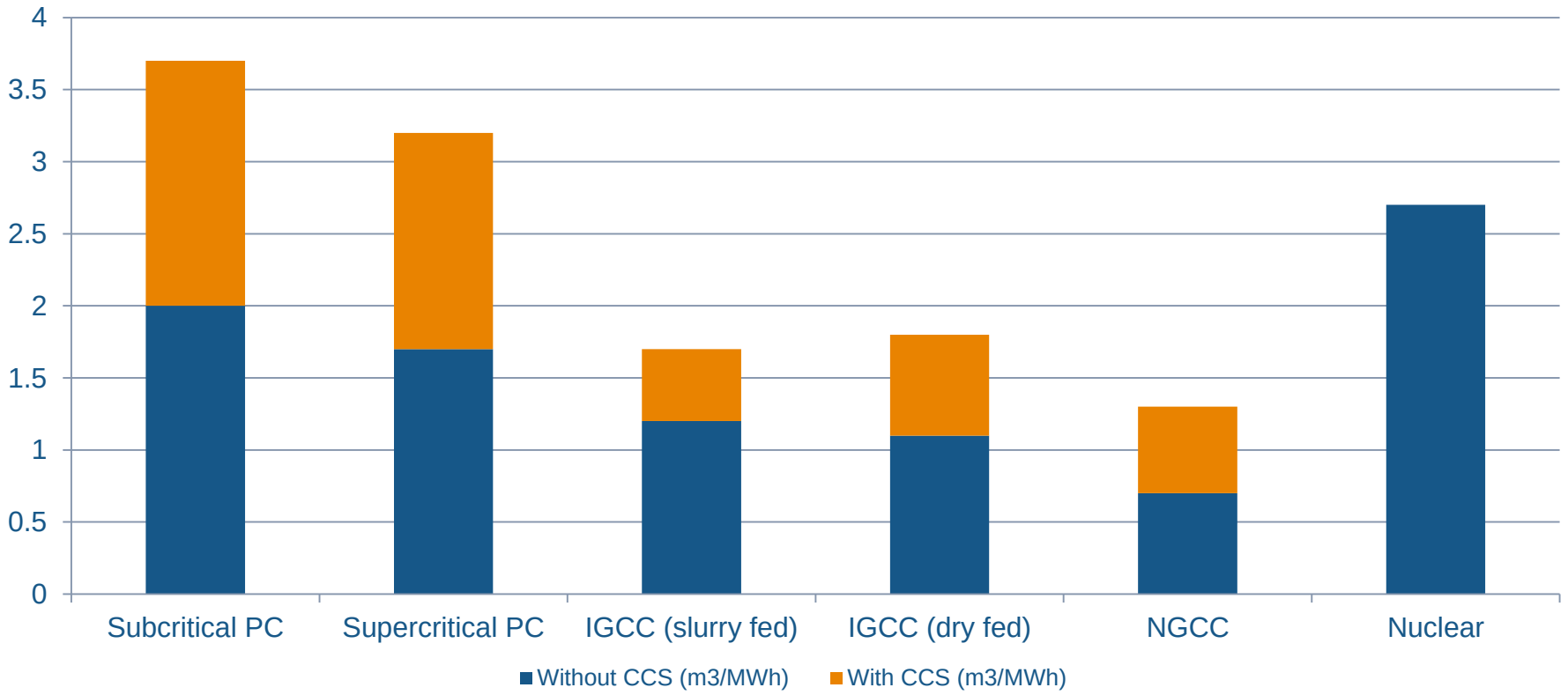
Source: Water for Energy, WEC, 2010



CCS - less CO_2 but more water

The Energy – Water – Food – Climate Nexus

Water consumption for thermoelectric power plants with / without CCS



- **CCS changes significantly the water for energy consumption of thermoelectric power plants**

Source: Water for Energy, WEC, 2010

Policy and Regulatory Frameworks

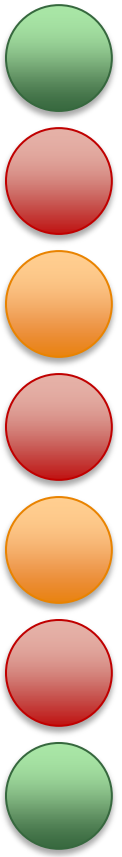
Increasing tightening and development of policy: UN conventions, multilateral and bilateral agreements, legislation and regulation – examples include:

- International:
  - Trans-Boundary aquifers (e.g. Guarani and Numbian);
  - Underground water resources (pending UN law) – **key as 96% of the world's fresh water comes from aquifers which straddle international boundaries**
- EU
  - Implementation of Water Framework Directive, EU Action Plan on offshore and coastal water, wind and energy, EC Green Paper on adoption to climate change, white paper on water scarcity (focus on energy sector), Groundwater pollution directive, Recommendation on water scarcity and droughts, Implementation of Renewable Directive in member states
- US:
  - TBC – possible actions on clean water issues

Increased concern and action by policymakers may drive action that restricts operational flexibility and increases compliance costs

Energy mix in 2050 – water perspective

- **Energy efficiency** and energy conservation are absolutely crucial in dealing with demand outstripping supply
- **Coal** remains a dominant fuel (especially in China and India), some potential for coal to liquids (CTL), increasing challenges around CCS
- **Natural gas** will gain more importance in the energy share
- **Oil** will continue to be the dominant fuel in transport
- **Nuclear** is not a game changer
- **Hydro**: great economic potential of hydro electricity generation especially in SSA and LAC
- Share of **renewables** (RES-E) could be increased



Water for Energy – Energy for Water

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Summing it up

- **The accelerating EWFC nexus requires rethinking infrastructure resilience: EWF security is increasingly intertwined and requires integrated planning and design of infrastructure.**
- **The future water needs of energy production and conversion will increase along with the overall increase of water stress. Energy efficiency measures can mitigate growing water consumption.**
- **Traditional biomass represents 90% of energy for water uses.**
- **Supply from unconventional sources is increasing, many of which (e.g., oil sands, oil shales, deep gas shales) require large amounts of water, adding further stress.**
- **Many emerging technologies show promise to mitigate the water footprint. RD&D efforts in this regard must be further increased (e.g. CCS, unconventionals).**
- **Great regional differences require specific examination and different solutions by region.**