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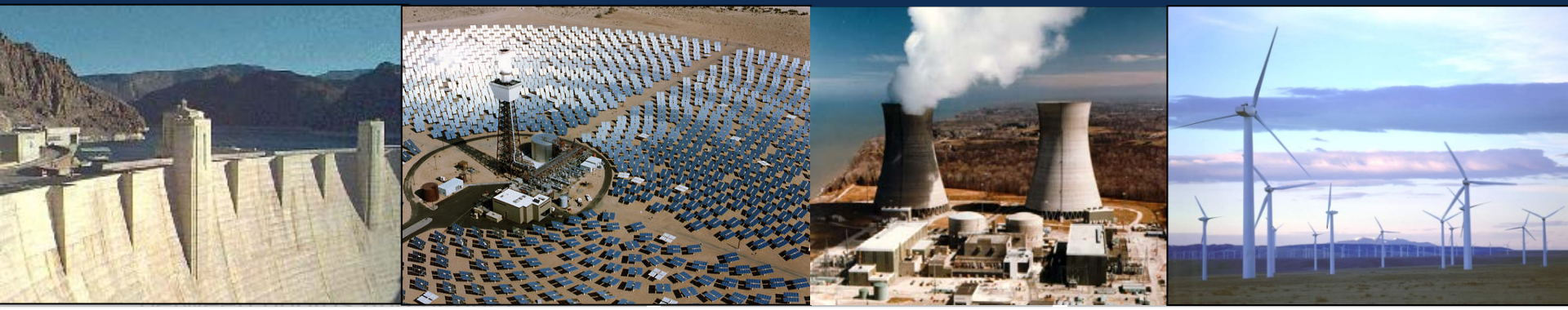

Energy-Water Nexus in the Asia-Pacific Region

Vincent Tidwell
Sandia National Laboratories
Asia-Pacific Energy Leaders Summit
Wellington, New Zealand
March 16-17, 2016

U.S. DEPARTMENT OF ENERGY | NNSA National Nuclear Security Administration

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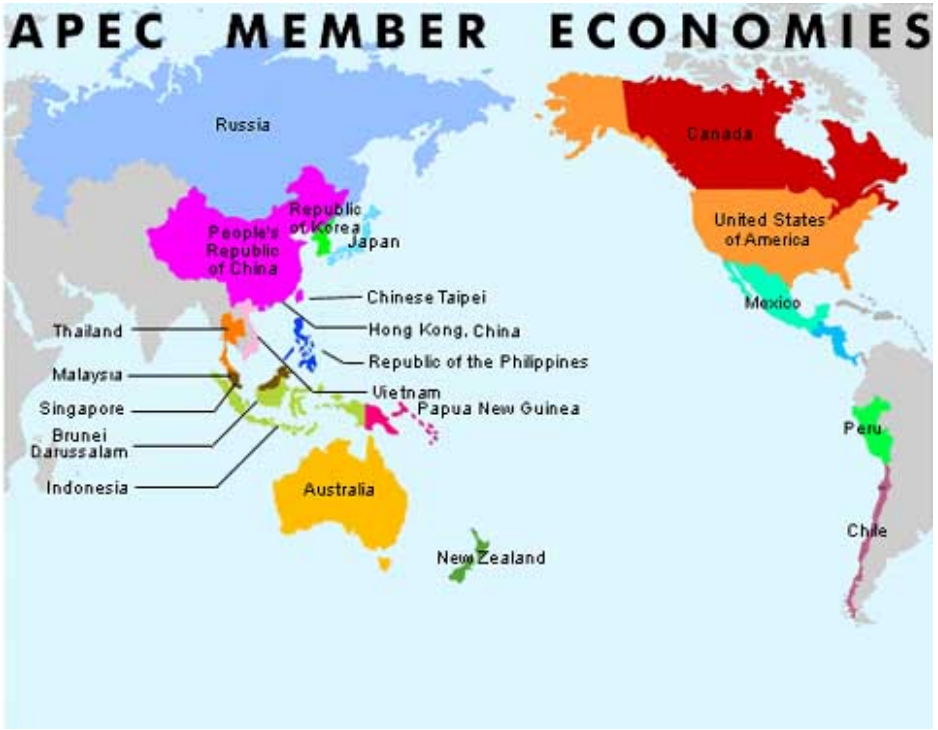
Energy-Water Quick Facts

- 90% of power production is water intensive.
- The International Energy Agency estimated (2010) global water withdrawals for energy production at 583 billion m^3 representing some 15% of the world's total withdrawals.
- Thermal power generation accounts for roughly 80% of global electricity production.
- Hydroelectricity accounts for about 15% of global electricity production.
- By 2035, global water withdrawals for energy are expected to increase by 20%, whereas water consumption for energy is expected to increase by 85%.
- 8% of world's energy production is used in the water sector.

UN World Water Development Report 2015

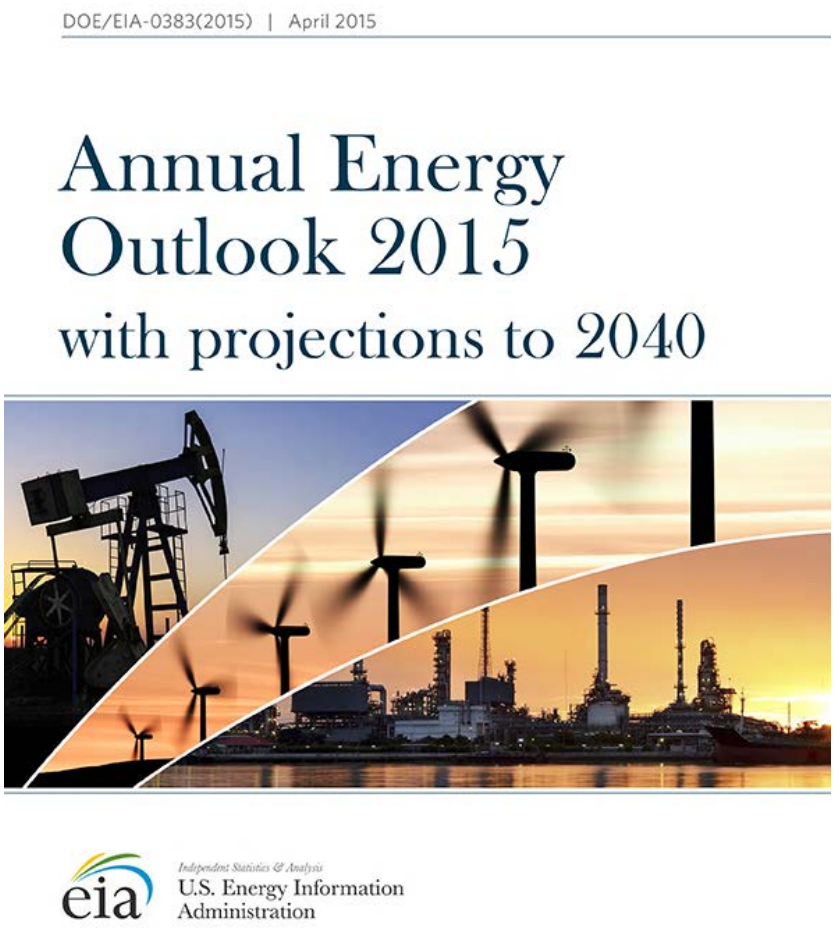
Objectives

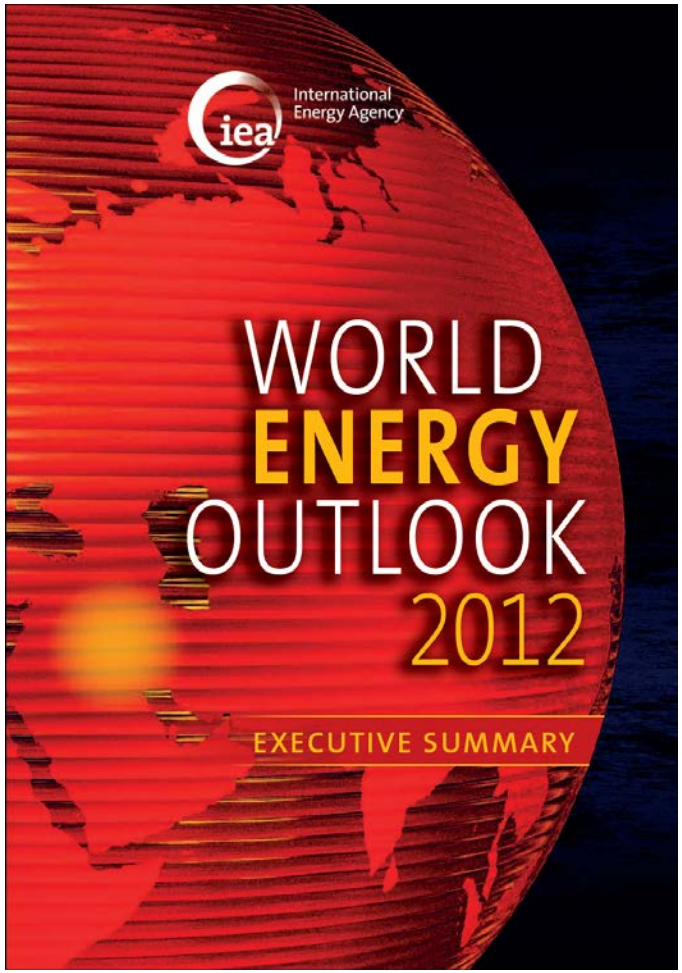
- Support the Asia-Pacific Economic Cooperation by investigating the Energy-Water Nexus in each member economy:
  - Map water use for energy
  - Map energy use for water
  - Perform mapping at a regional level
  - Compare to measures of water stress



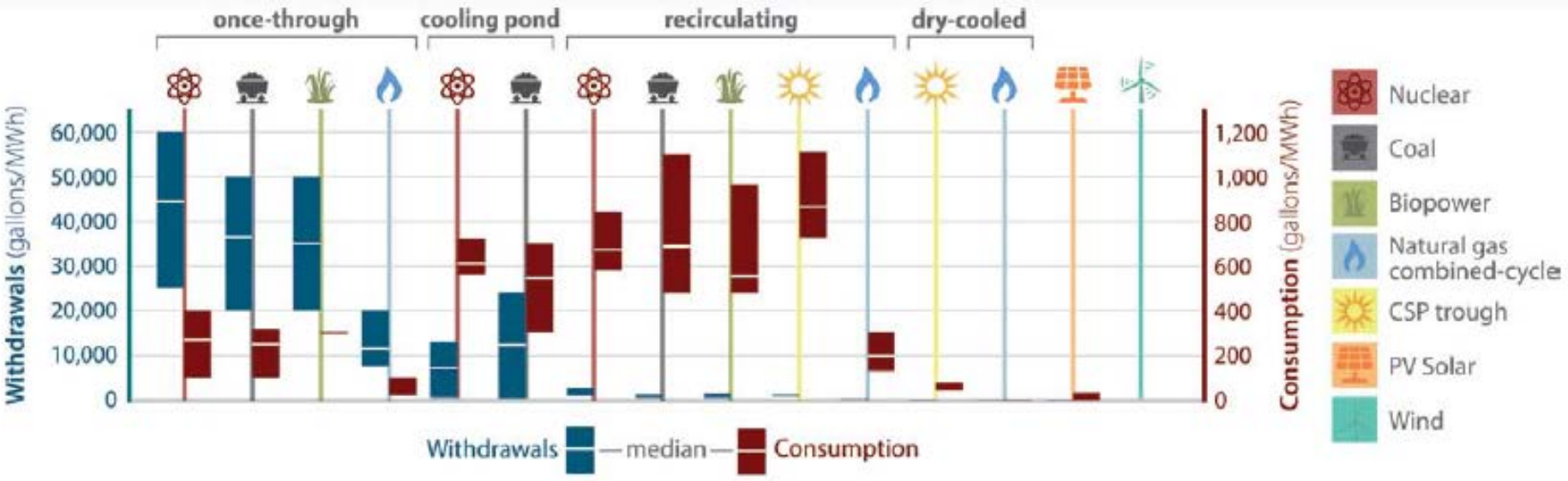
Methods

- Utilized publically available data





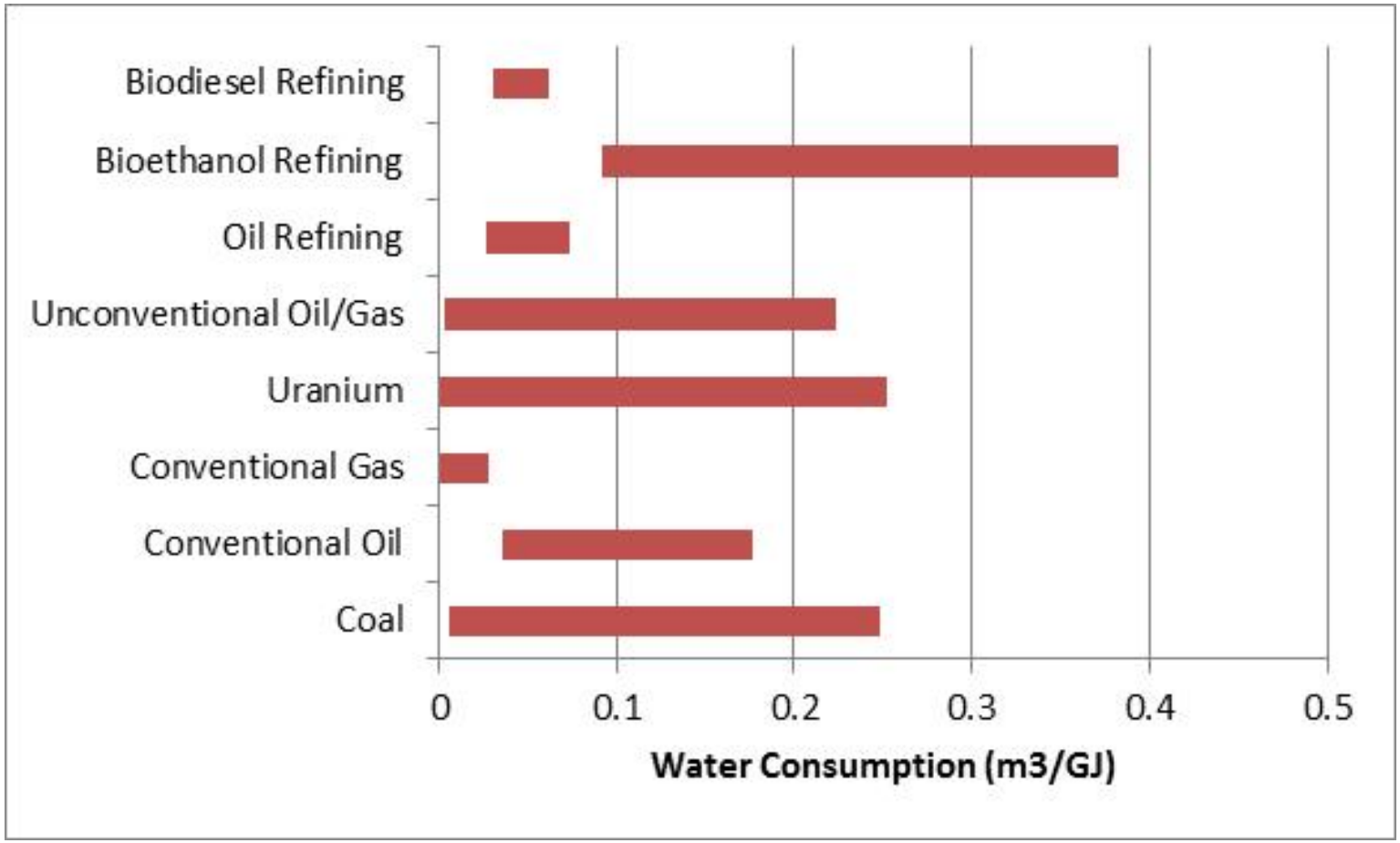
Water for Thermoelectric Production



Averyt et al. 2011

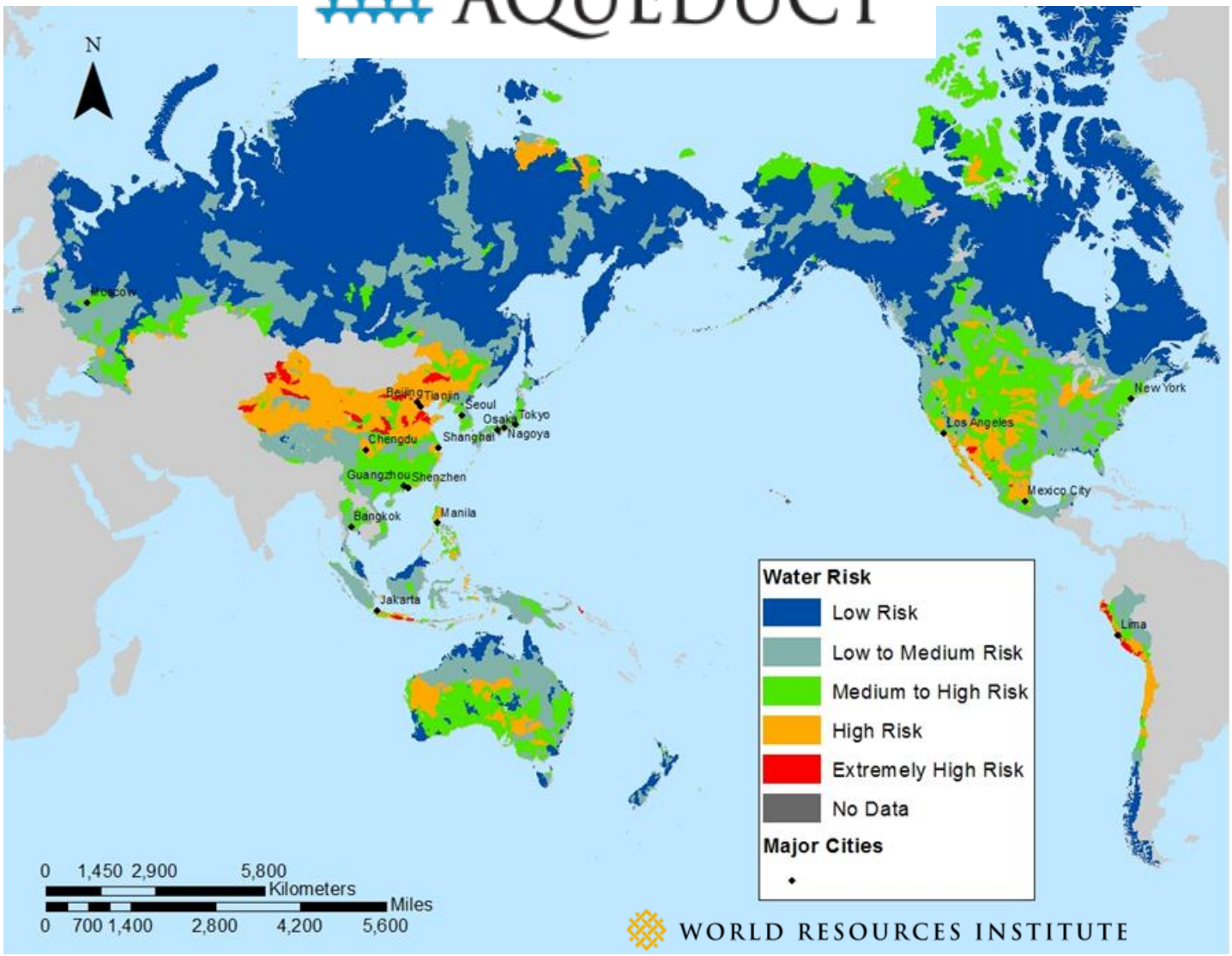
- Water use for thermoelectric production varies by:
  - Withdrawal vs. consumption,
  - Plant/fuel type, and
  - Cooling type.

Water for Energy Extraction and Processing

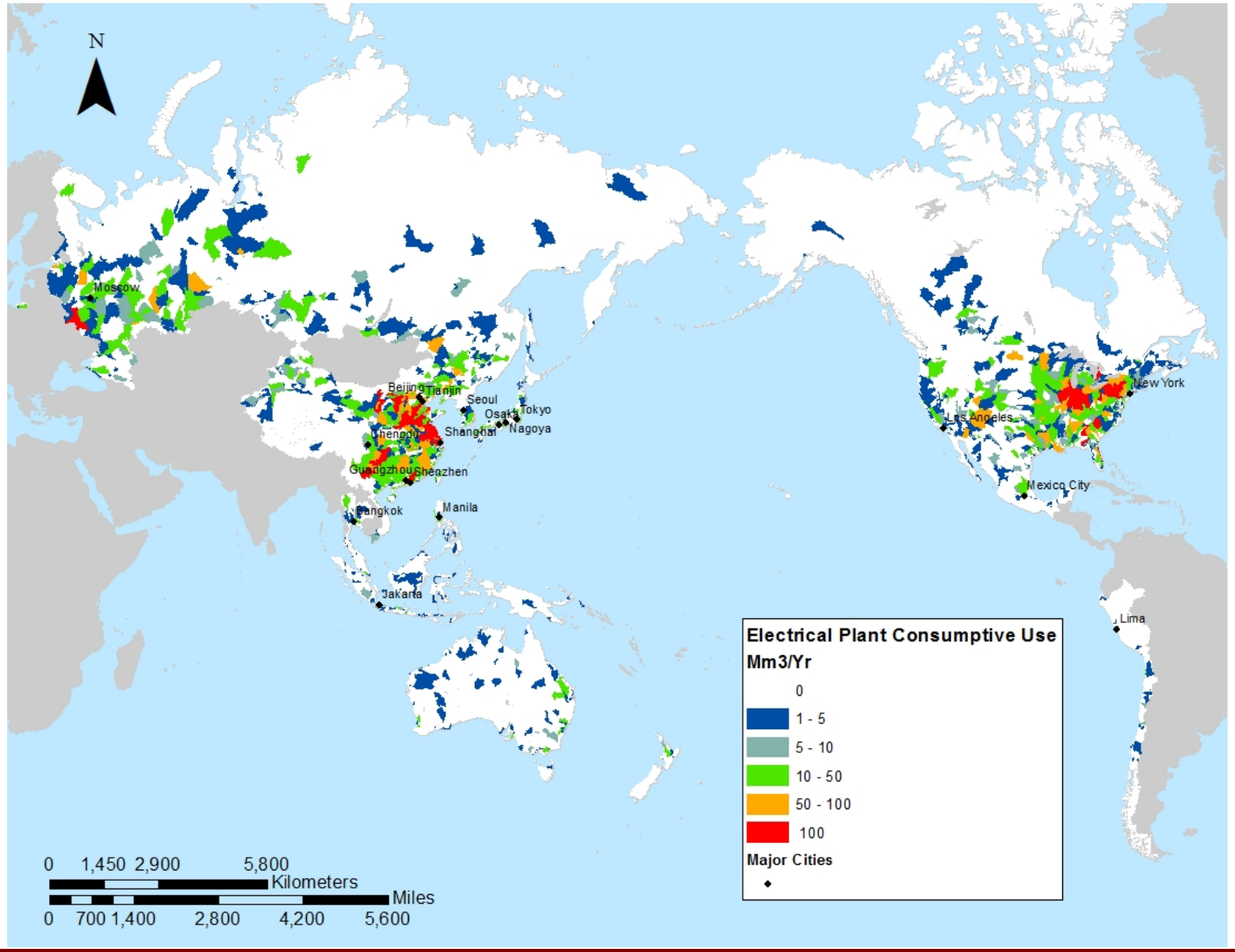


Source: Spang and others 2014

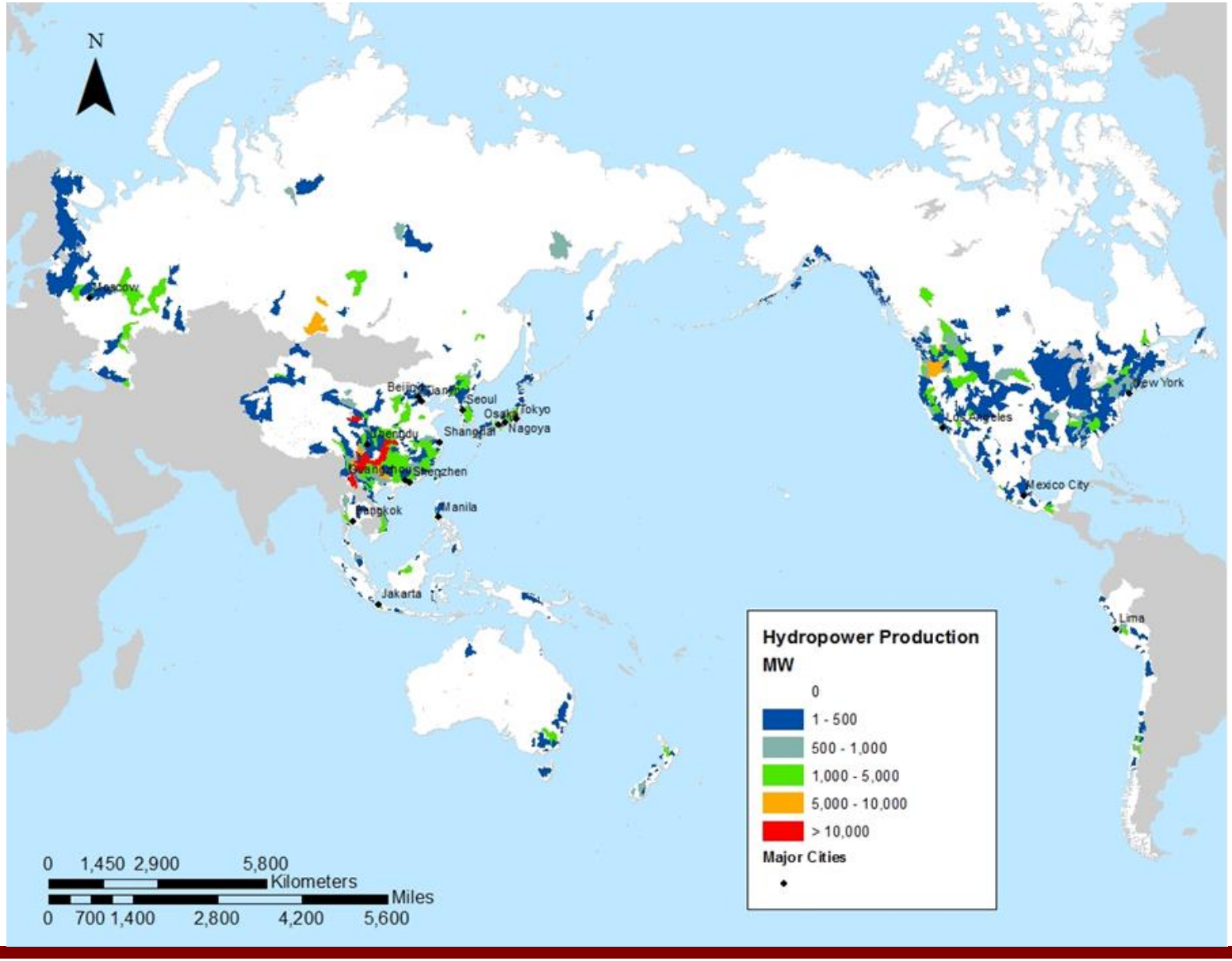
Global Water Risk Mapping



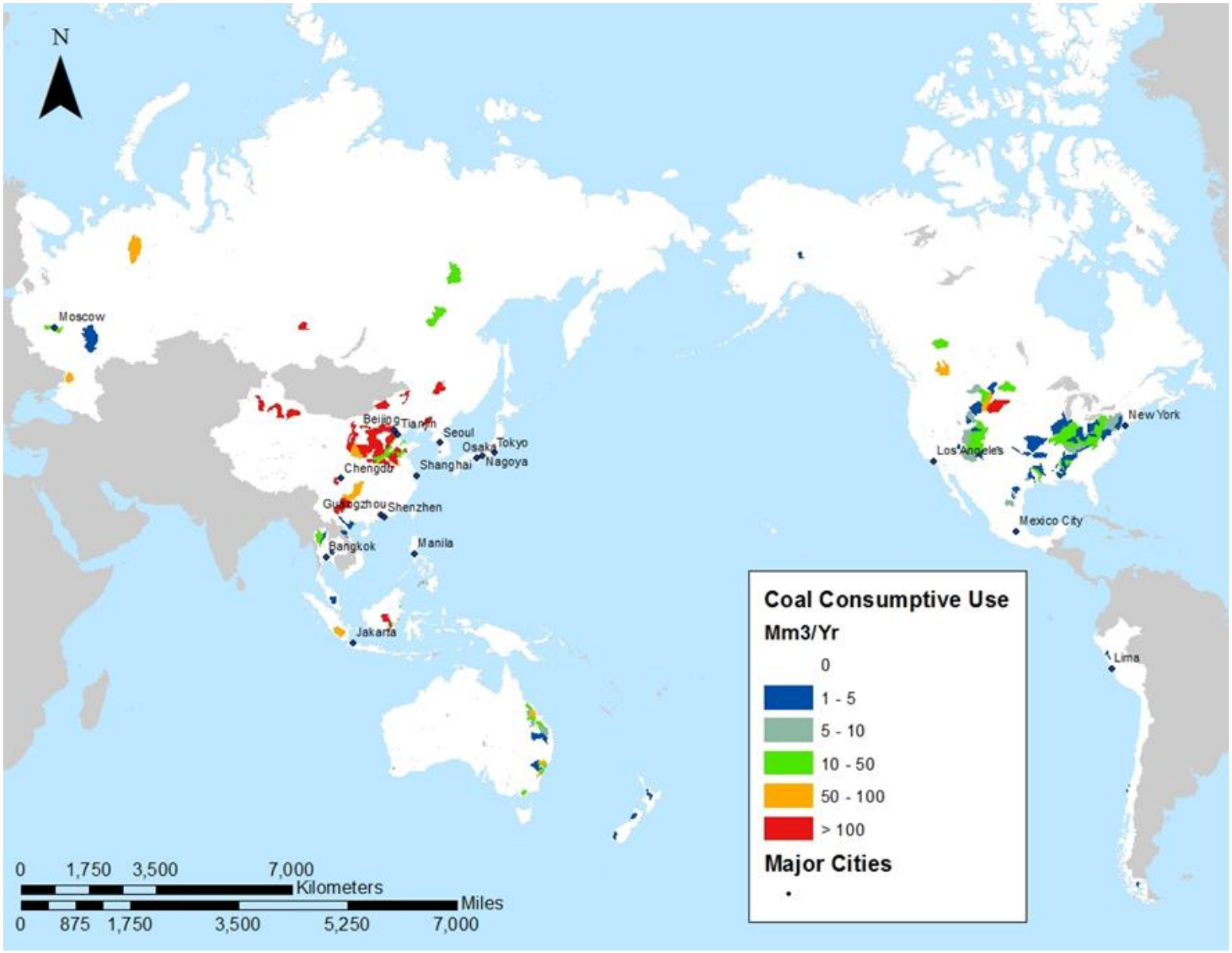
Water for Thermoelectric Power



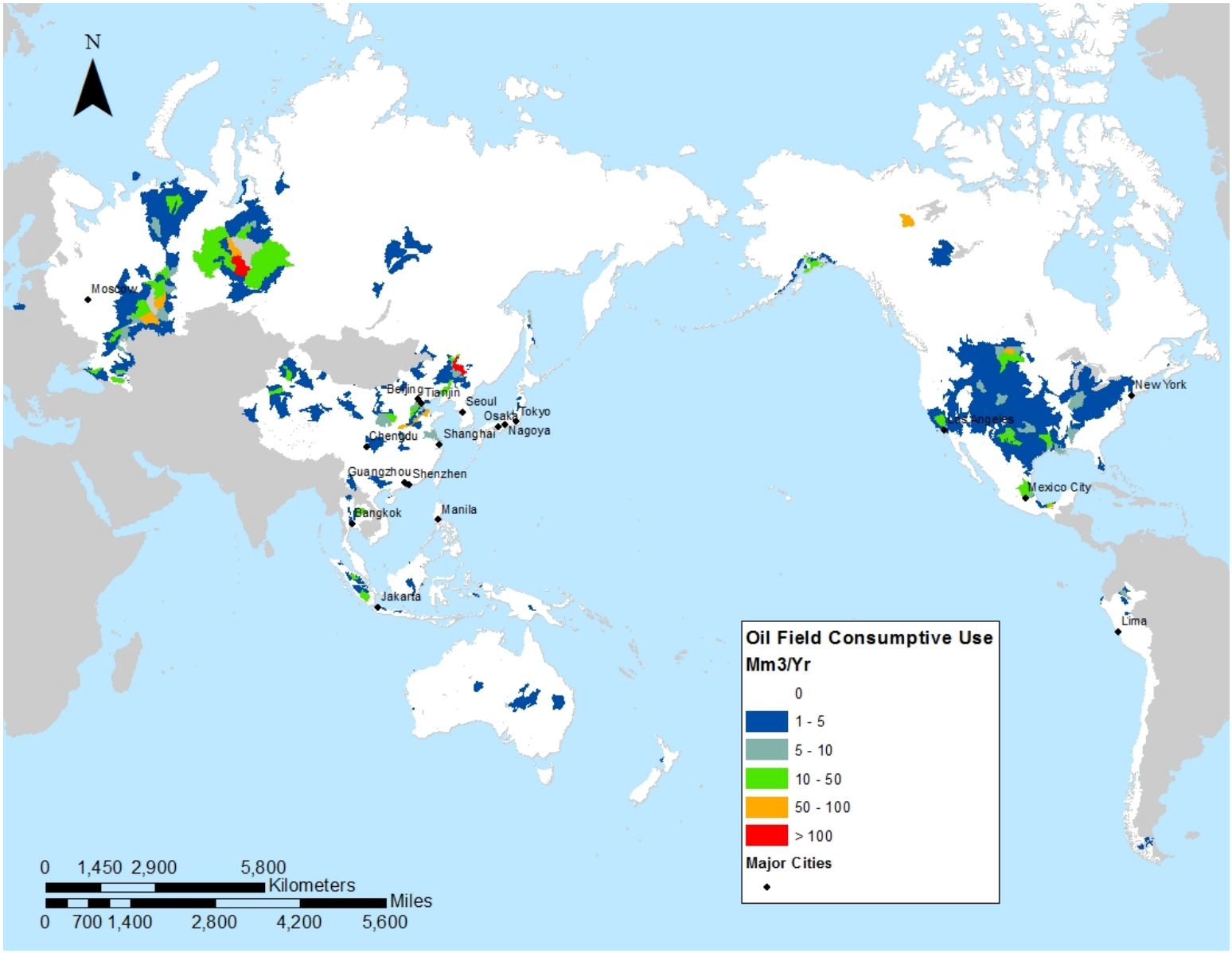
Hydroelectric Power (MW)



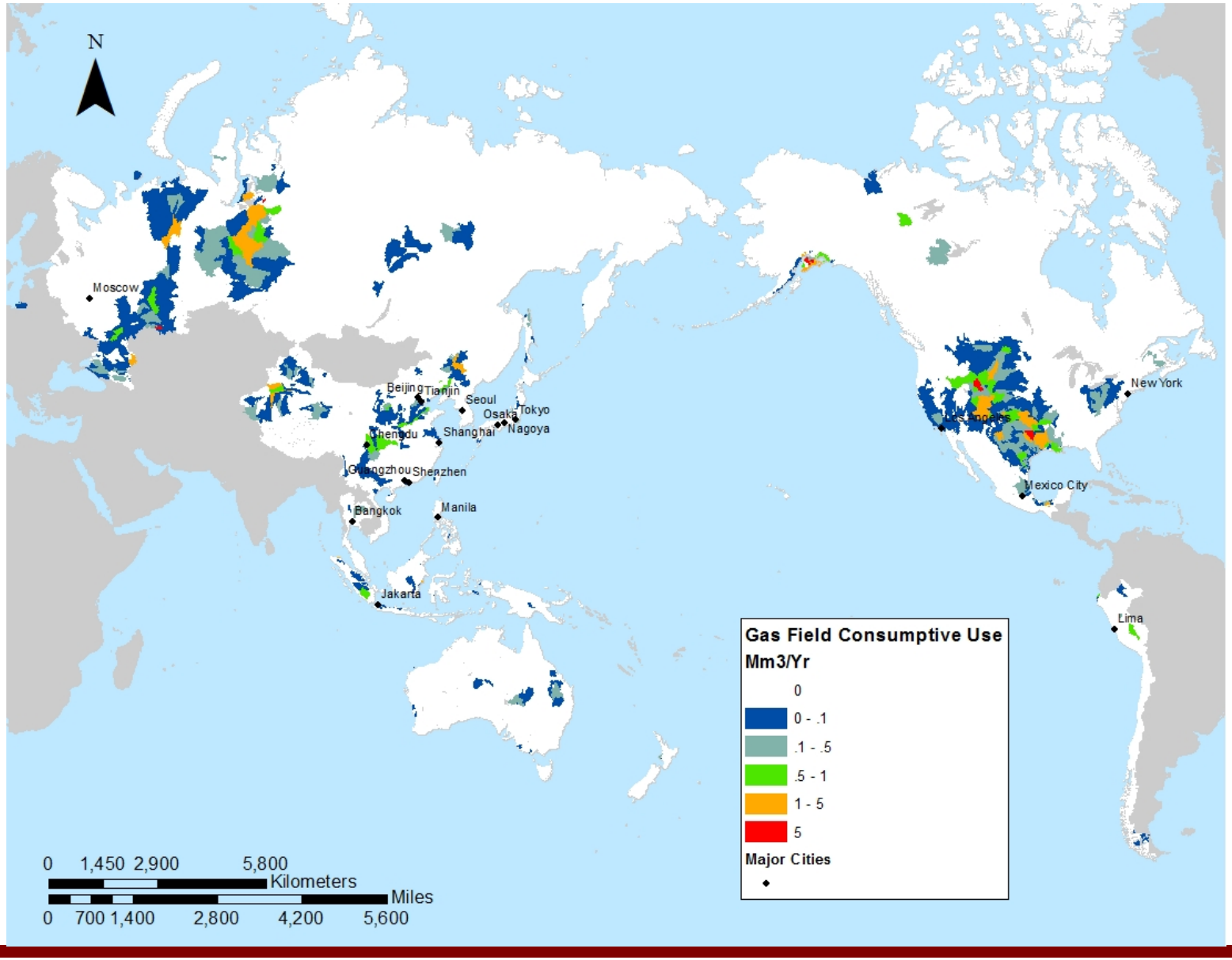
Water for Coal Extraction



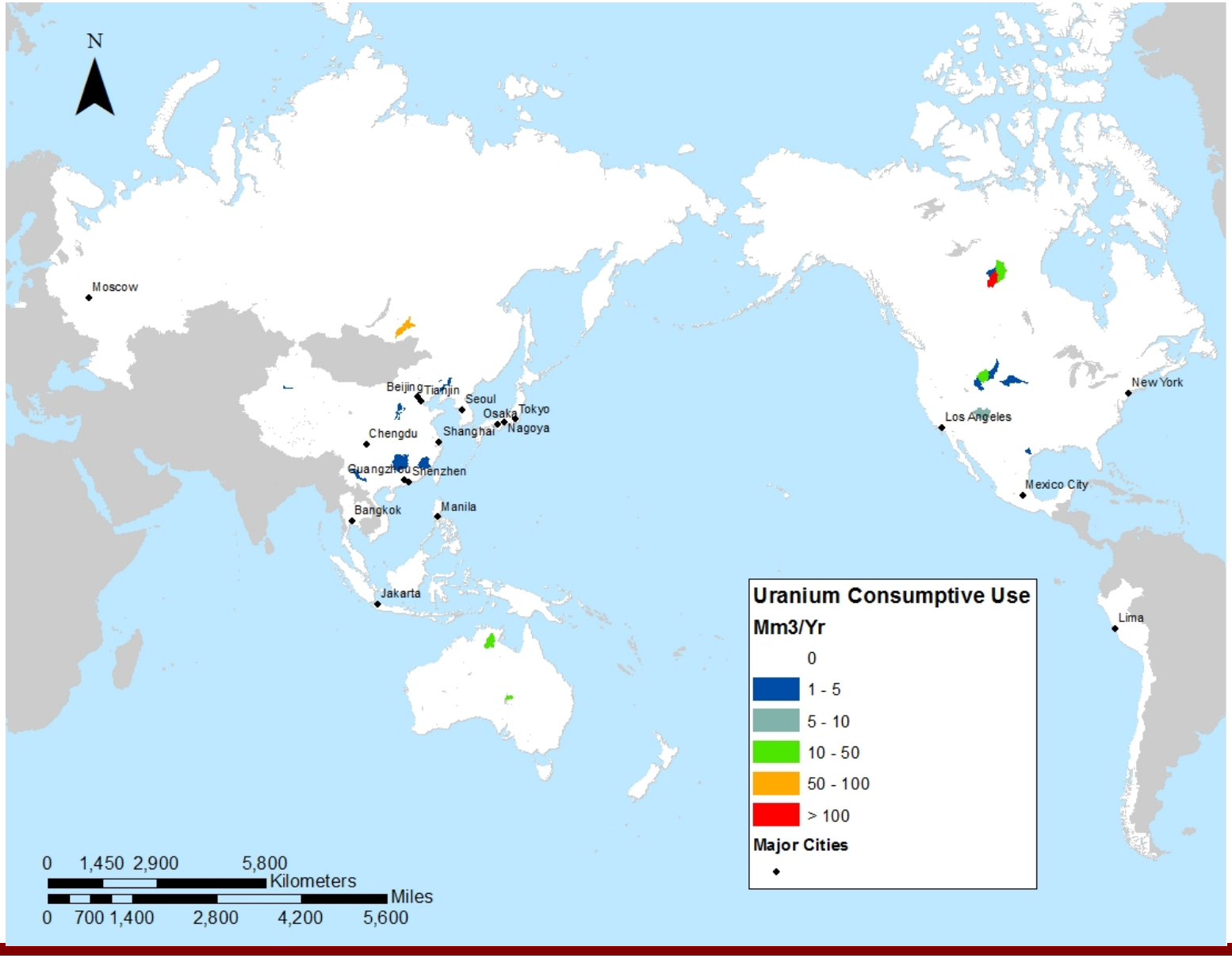
Water for Oil Extraction



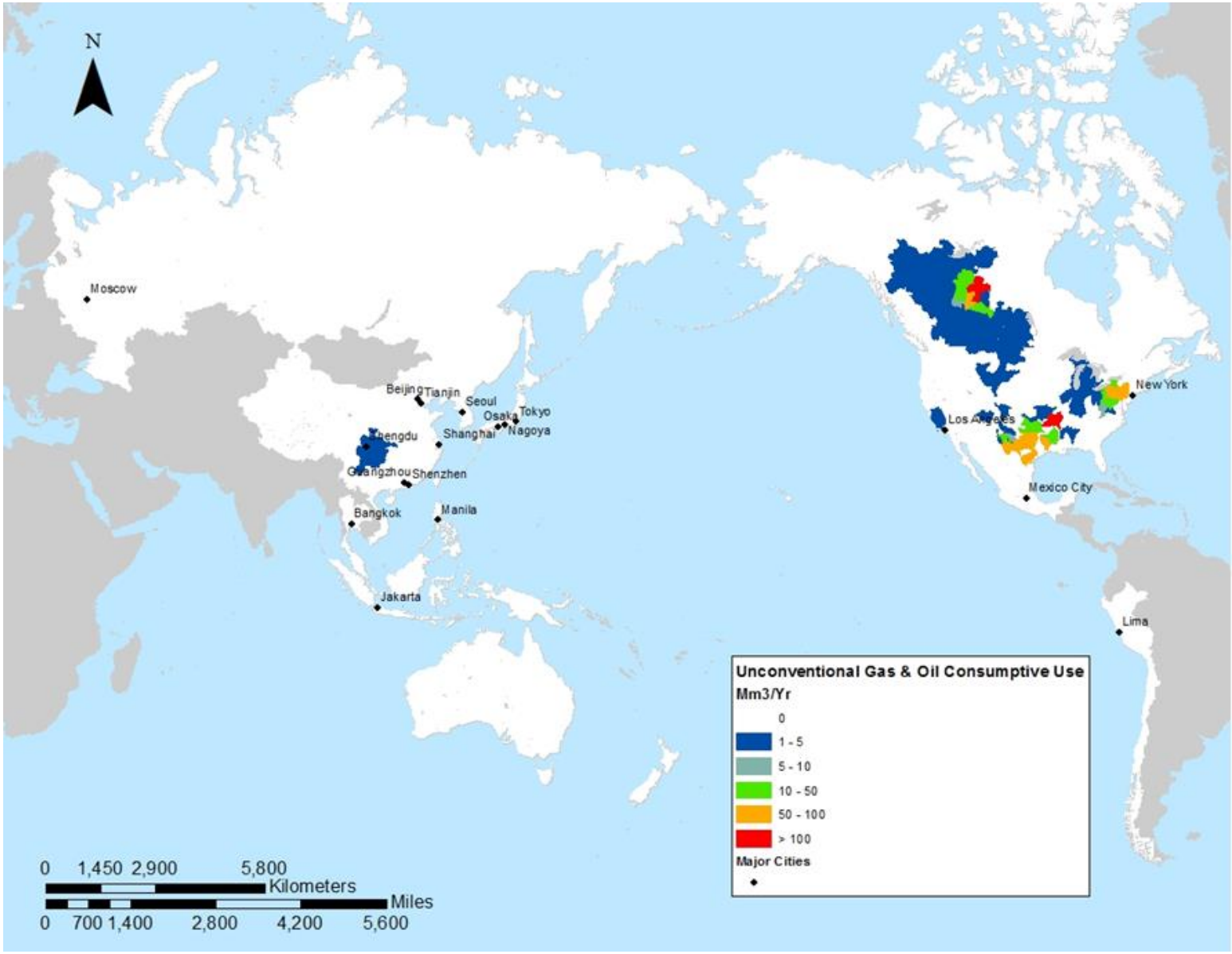
Water for Natural Gas Extraction



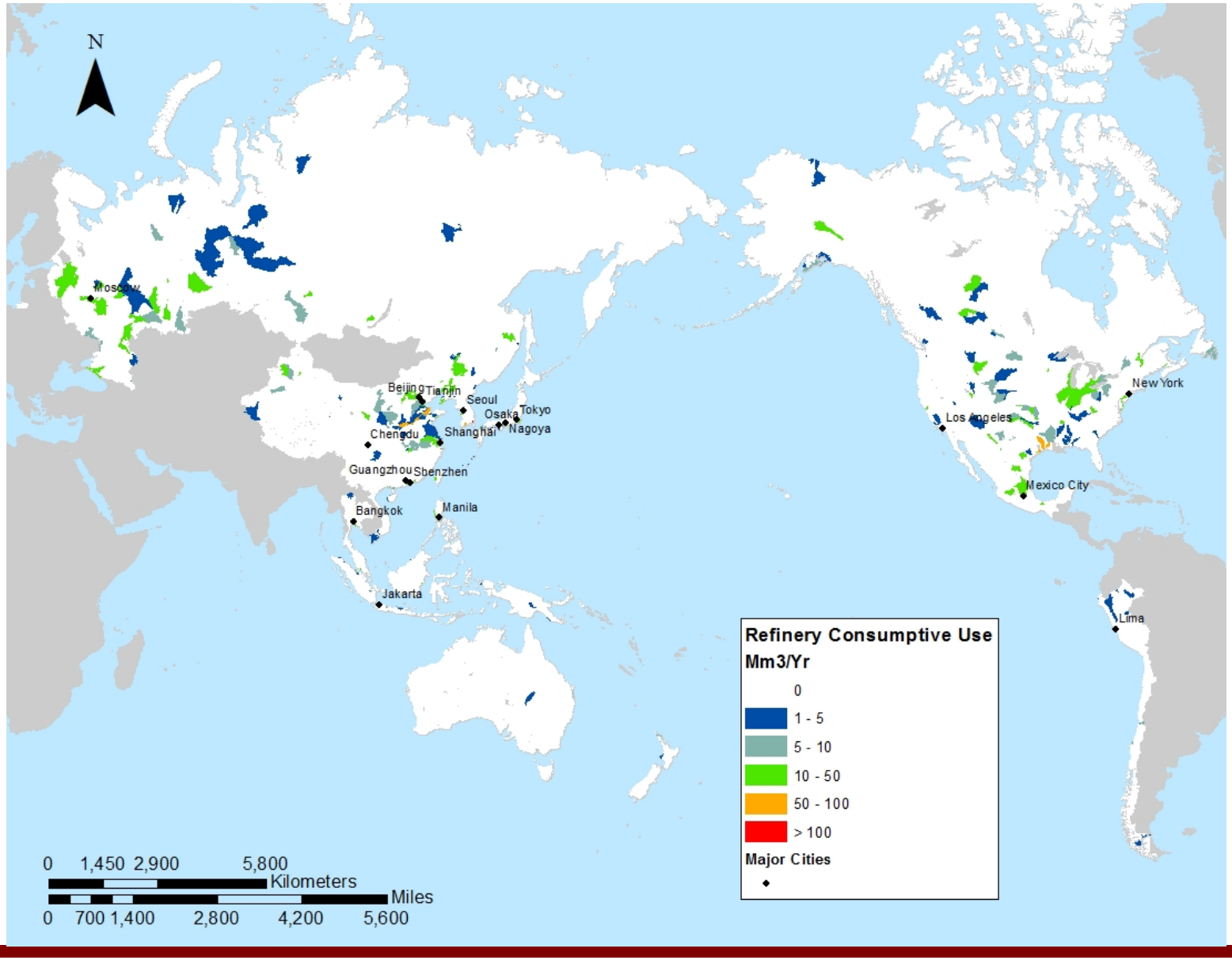
Water for Uranium Extraction



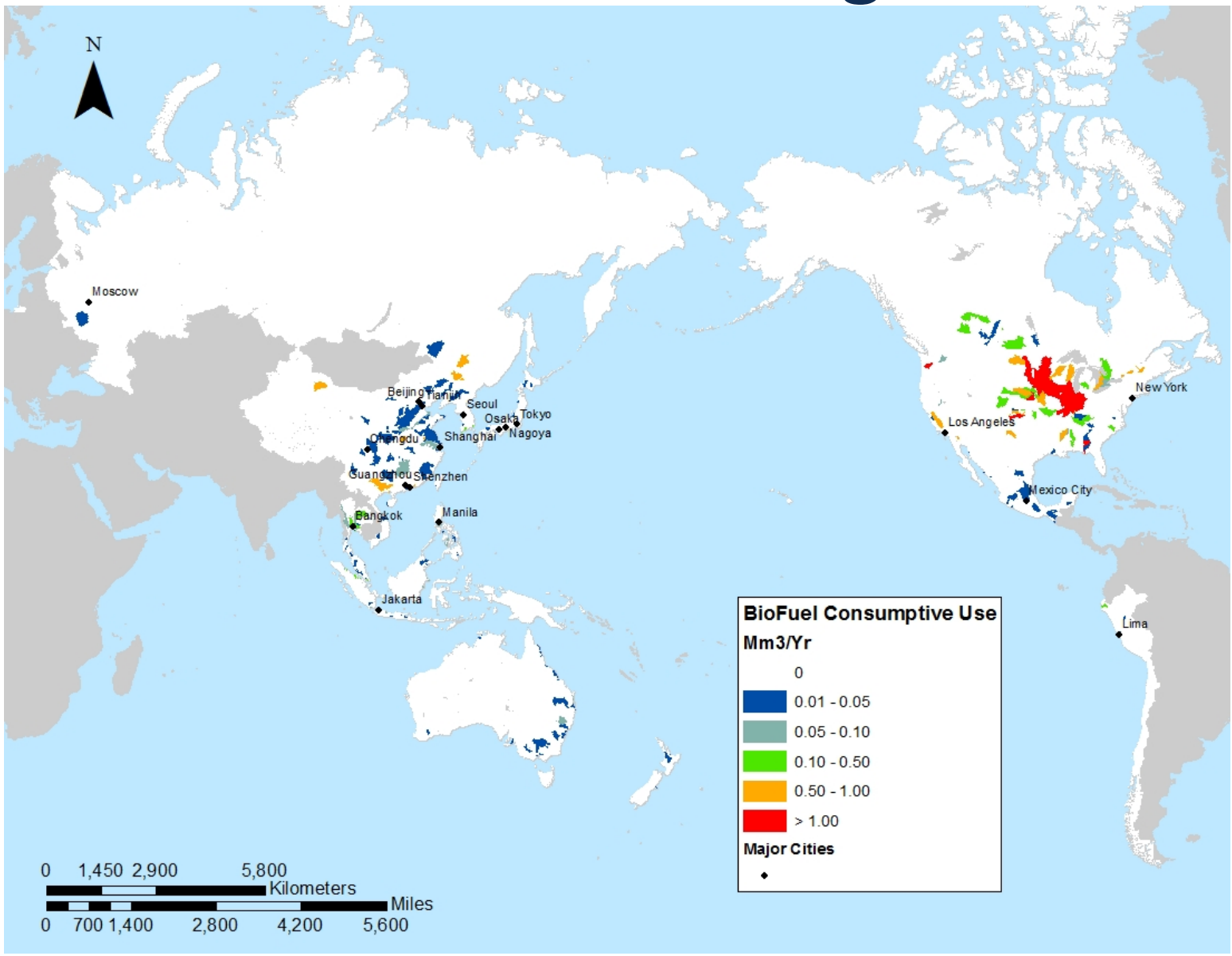
Water for Unconventional Oil and Gas



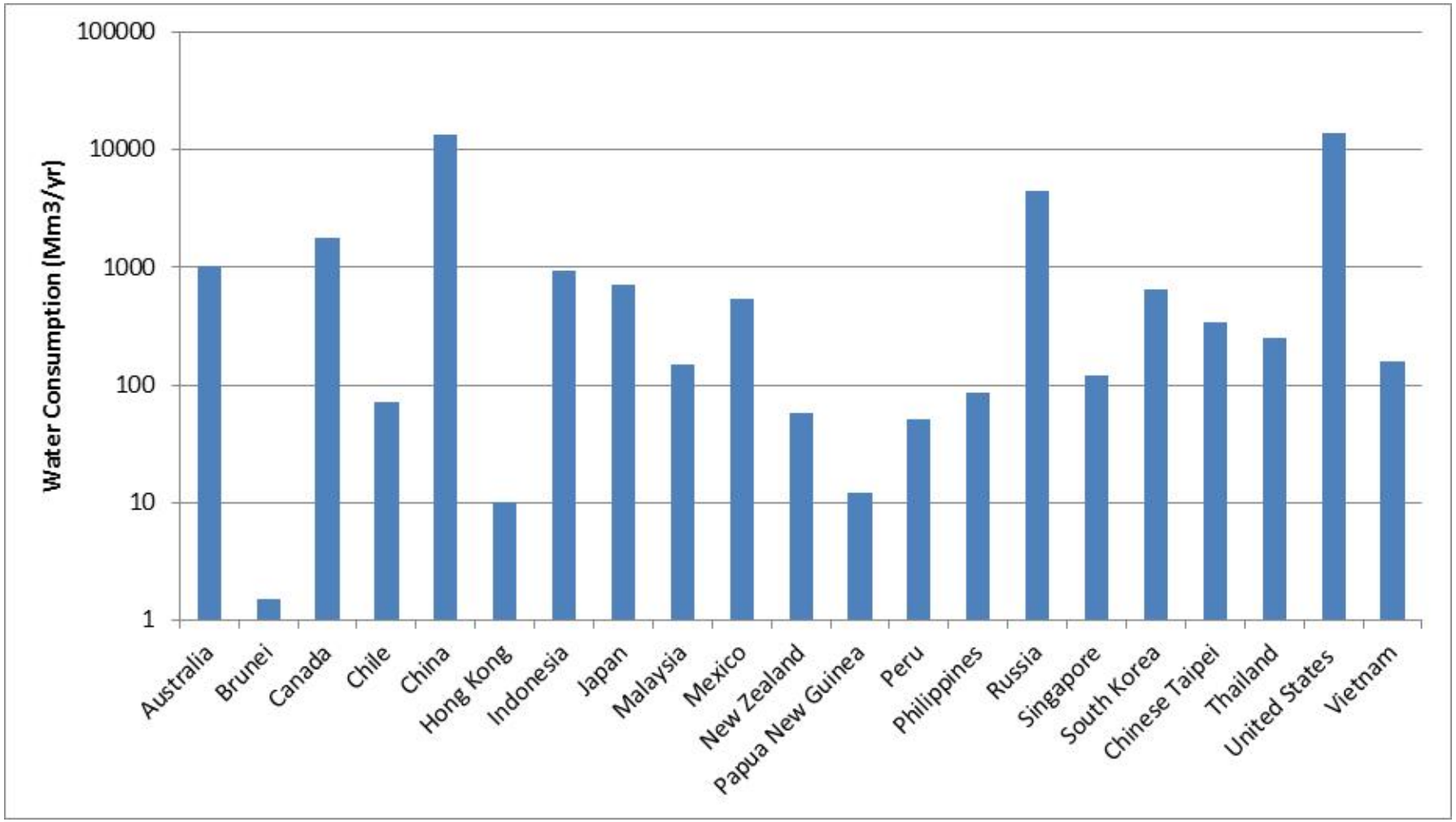
Water for Oil Refining



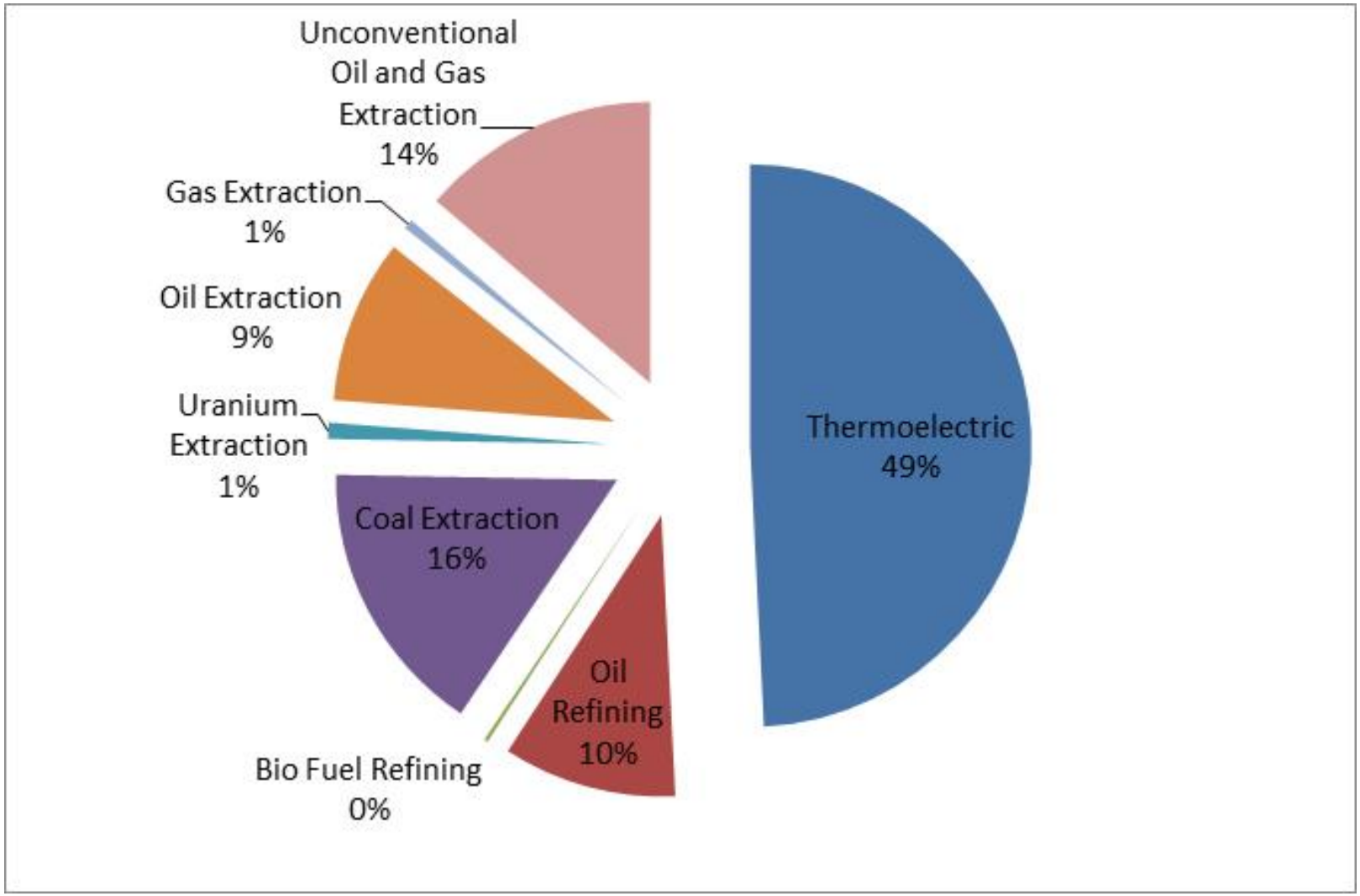
Water for Biofuel Refining



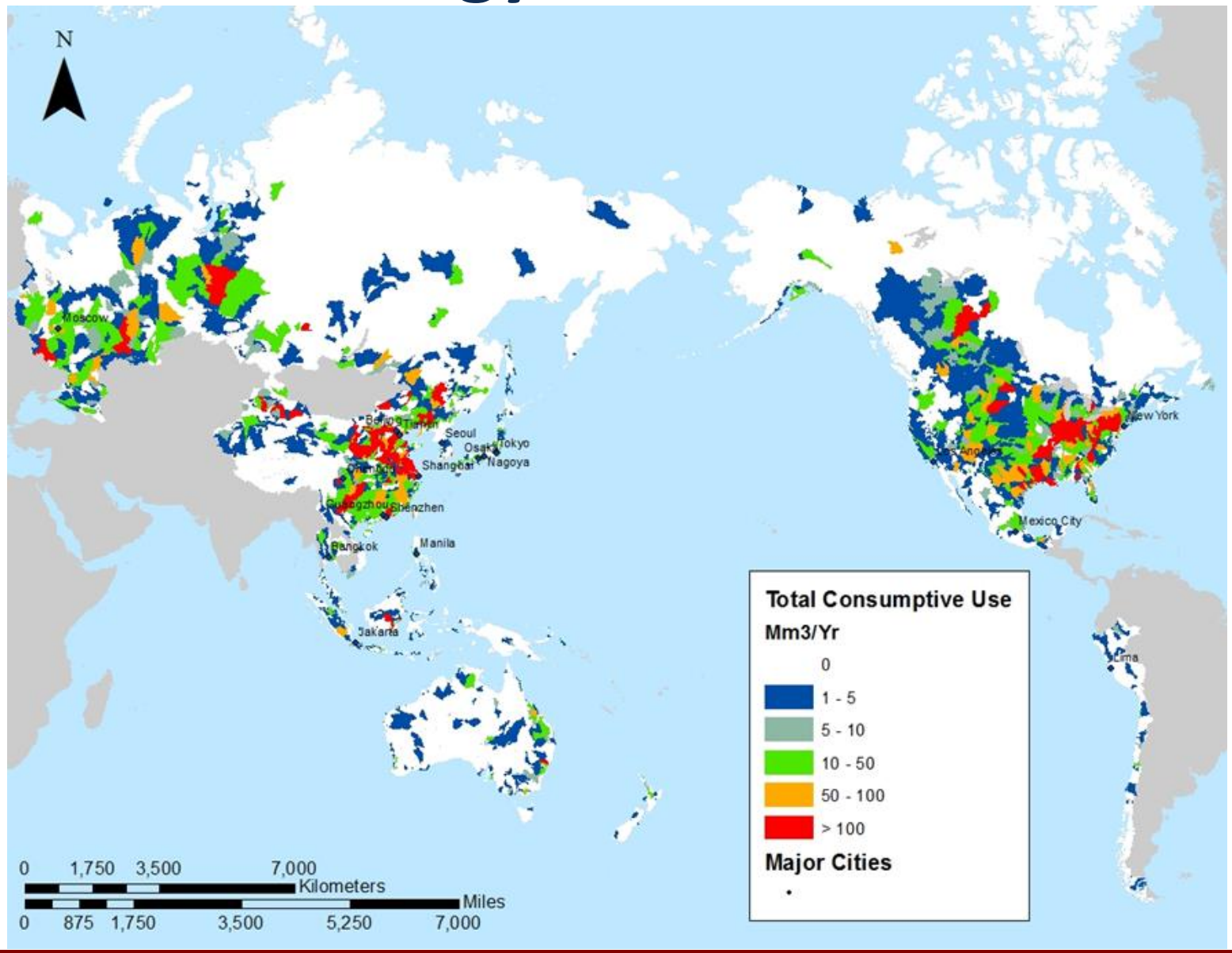
Water for Energy by Economy



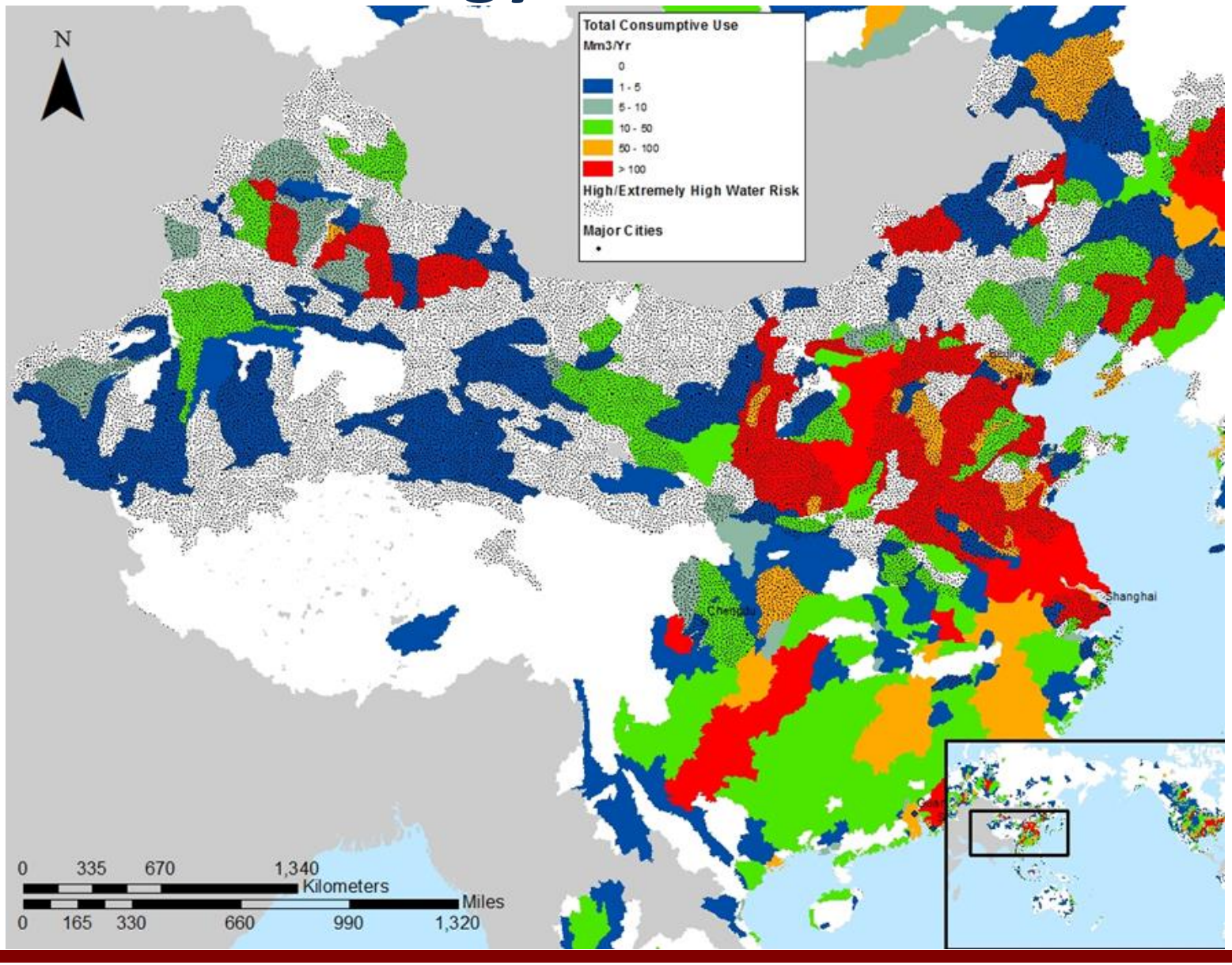
Water for Energy by Sector



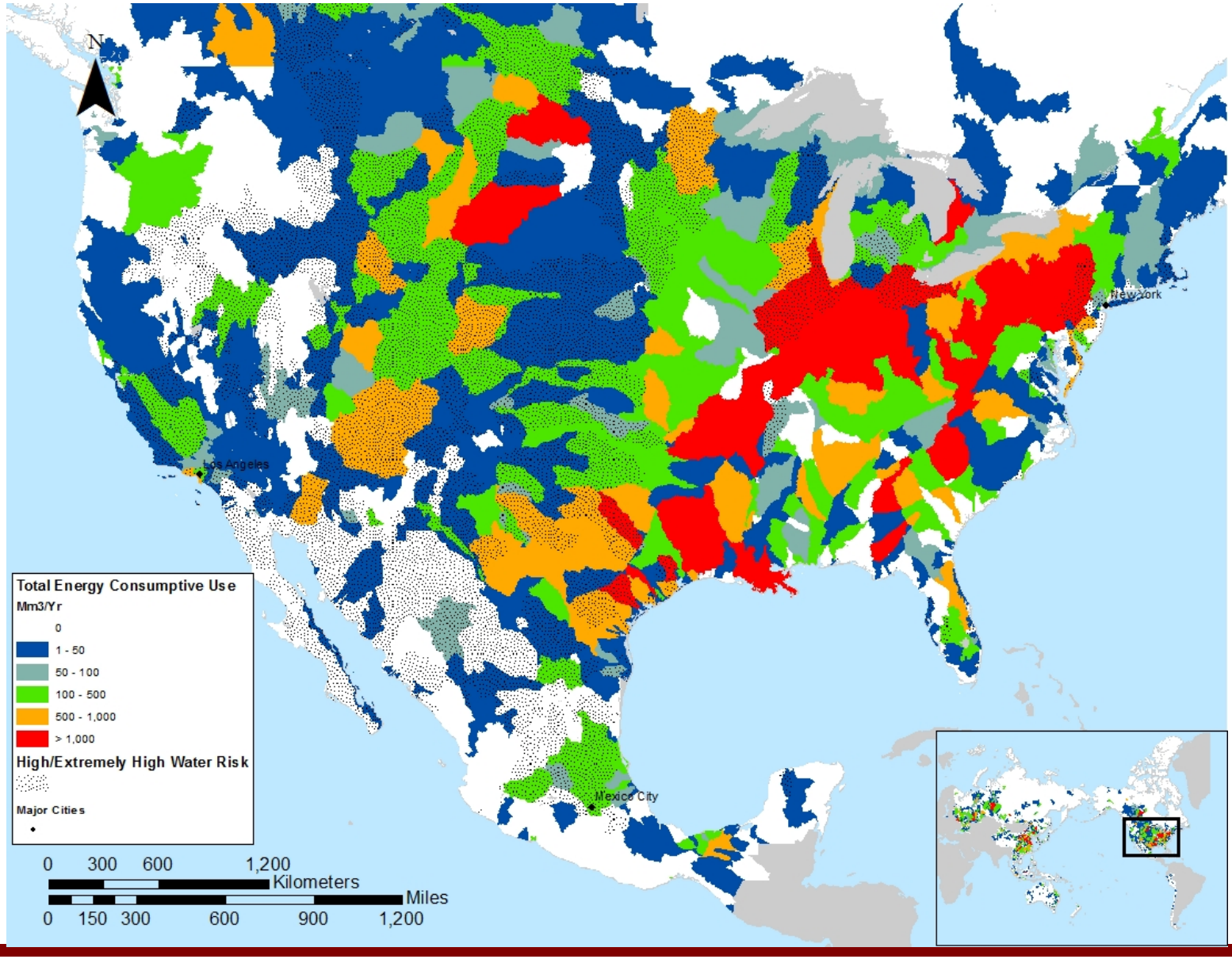
Water for Energy with Water Stress



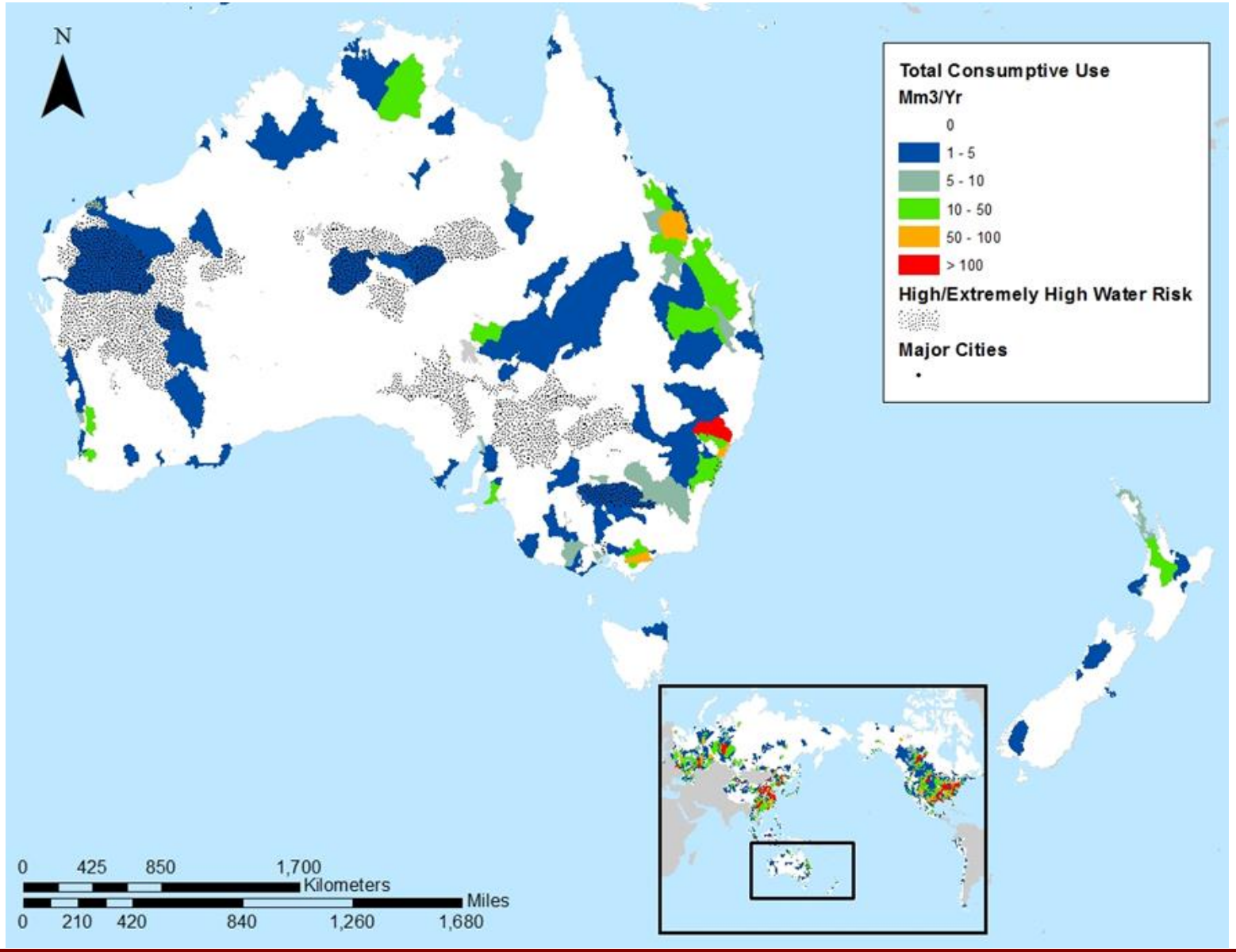
Water for Energy: Detail China



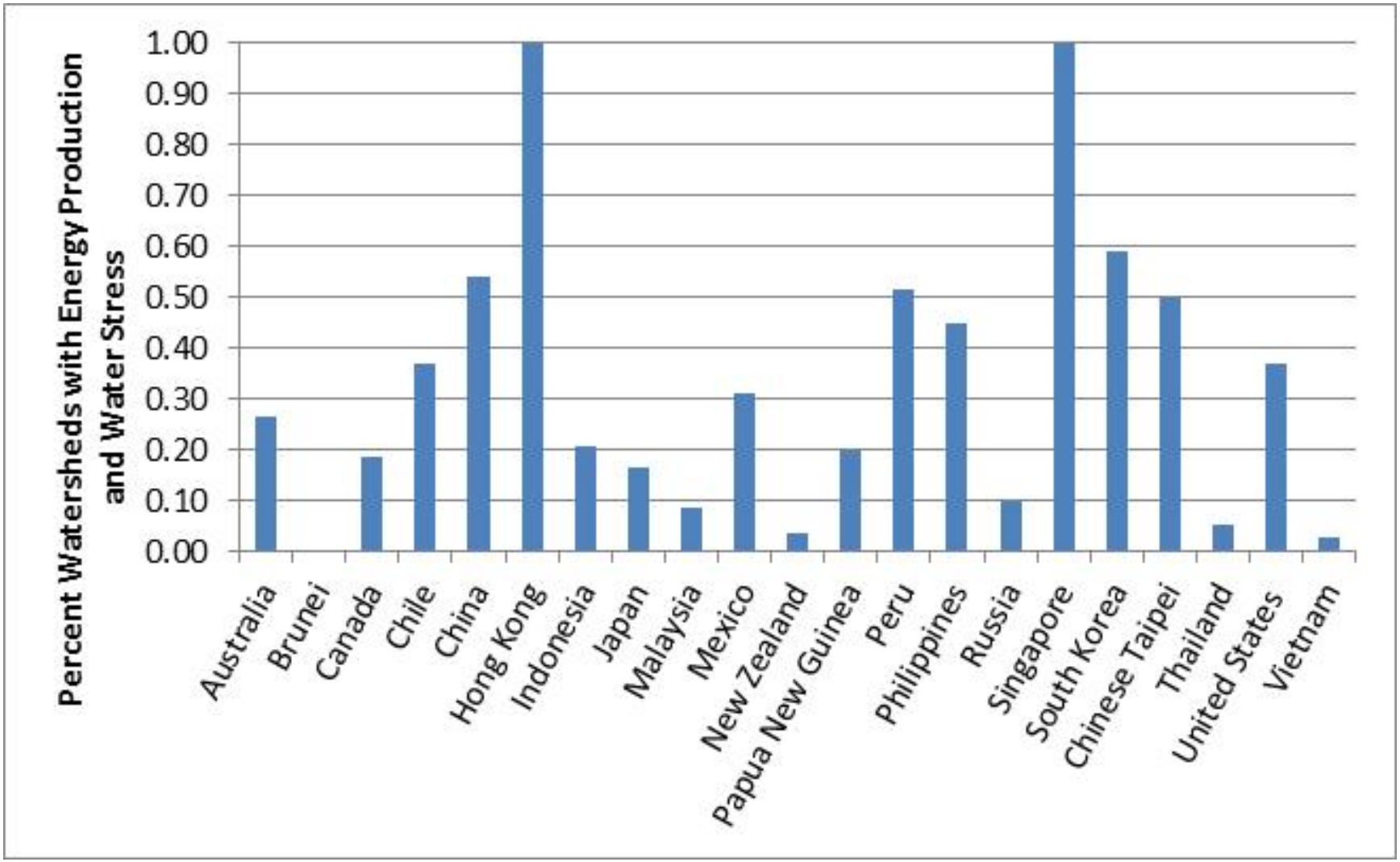
Water for Energy: Detail United States



Water for Energy: Detail Australia



Energy-Water Risk



Opportunities

- Options to improve energy-water resiliency:
  - Integrated energy and water planning,
  - Choice in energy production technology (e.g., low water use electricity generation),
  - Consider early the energy or water intensity of new projects and site them appropriately,
  - Numerous emerging technologies that can improve interdependencies:
    - Power plant cooling systems,
    - Water treatment technologies, and
    - Energy capture for wastewater streams.

- Project data available at:

http://energy.sandia.gov/?page_id=1741

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