

Exceptional service in the national interest



Energy-Water Nexus in the Asia-Pacific Region

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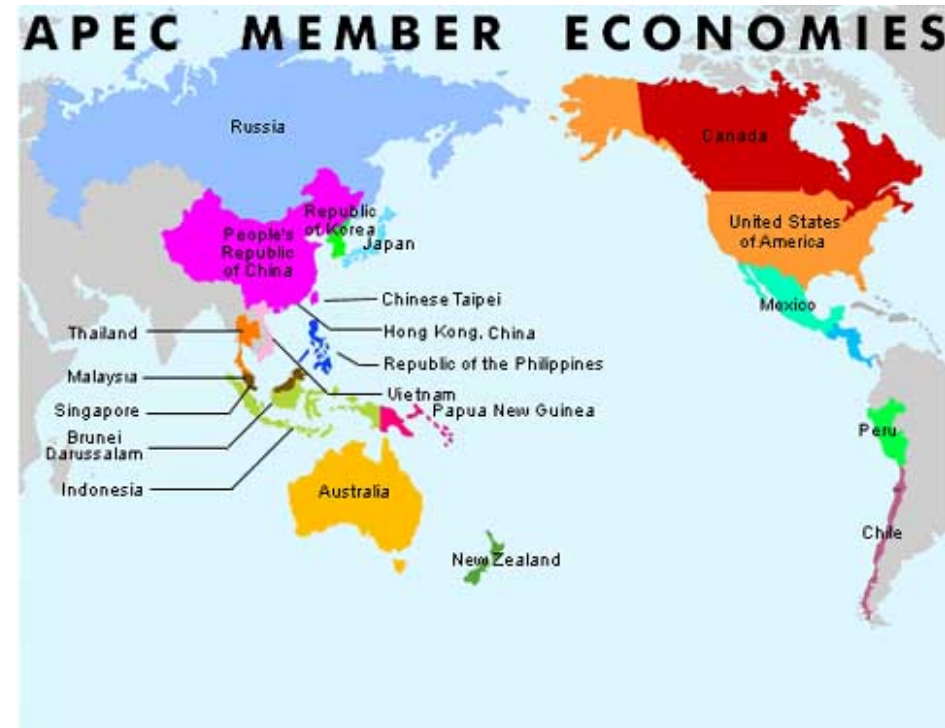
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Energy-Water Quick Facts

- 90% of power production is water intensive.
- The International Energy Agency estimated (2010) global water withdrawals for energy production at 583 billion m³ 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.

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

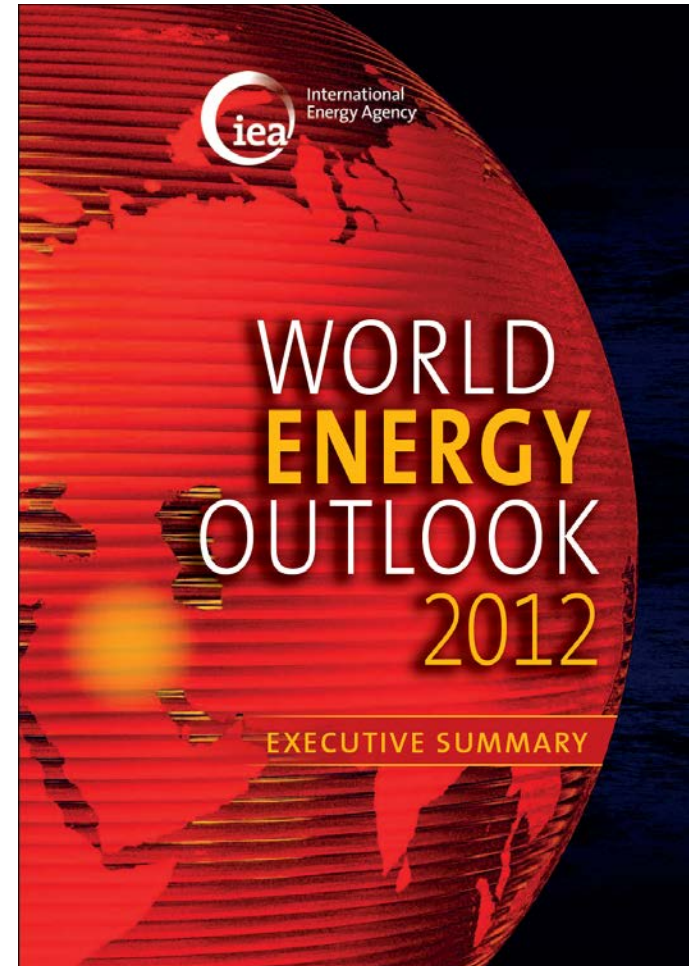
- Utilized publically available data

DOE/EIA-0383(2015) | April 2015

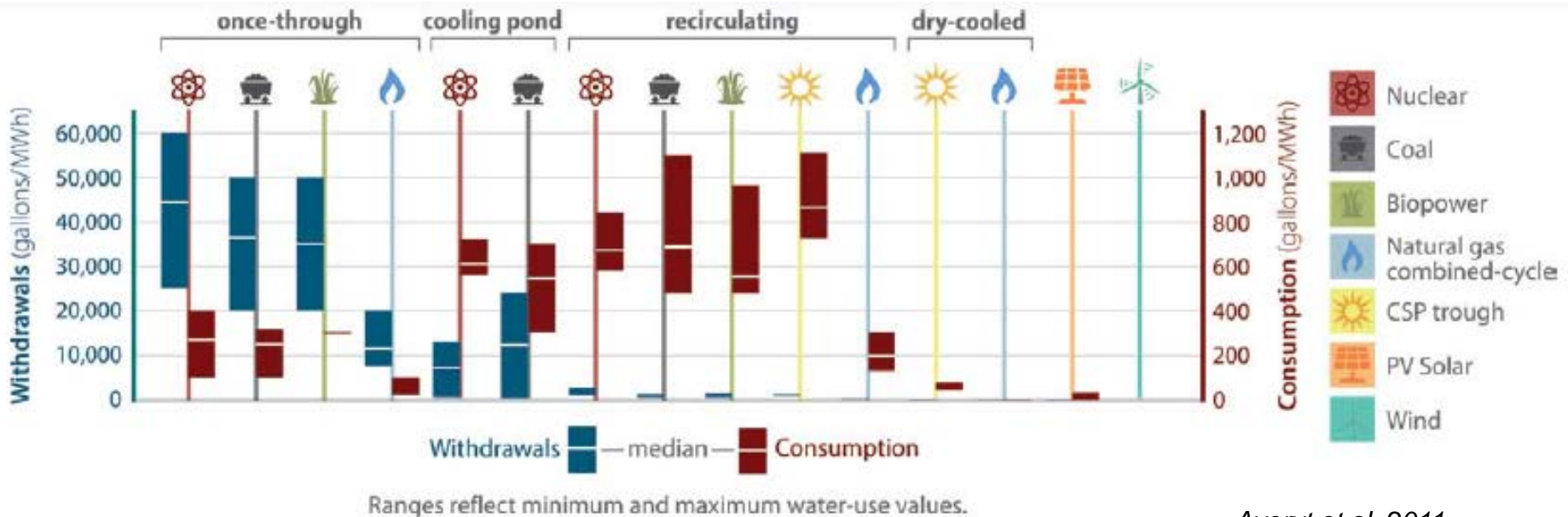
Annual Energy Outlook 2015 with projections to 2040



 *Independent Statistics & Analysis*
U.S. Energy Information
Administration



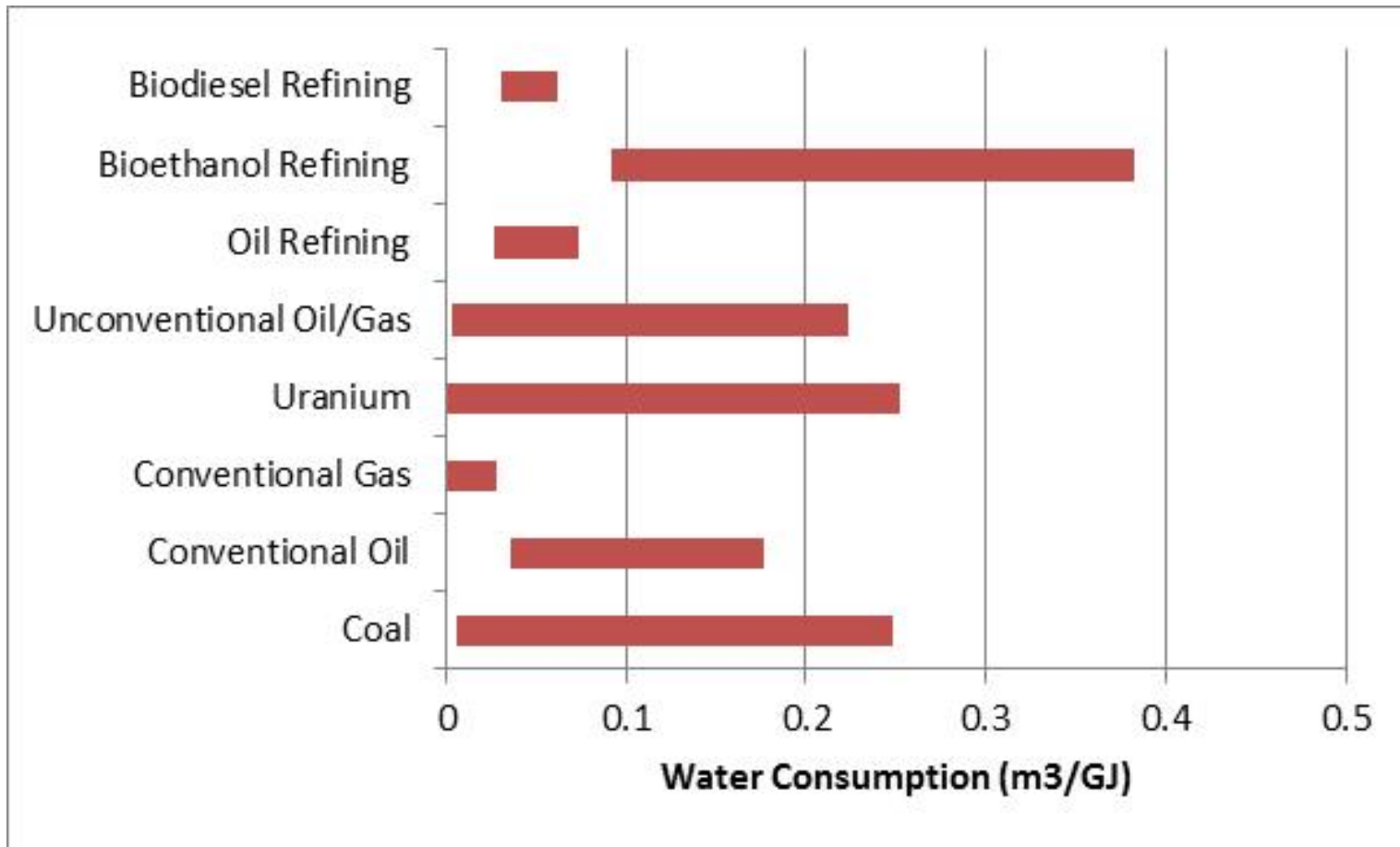
Water for Thermoelectric Production



Averyt et al. 2011

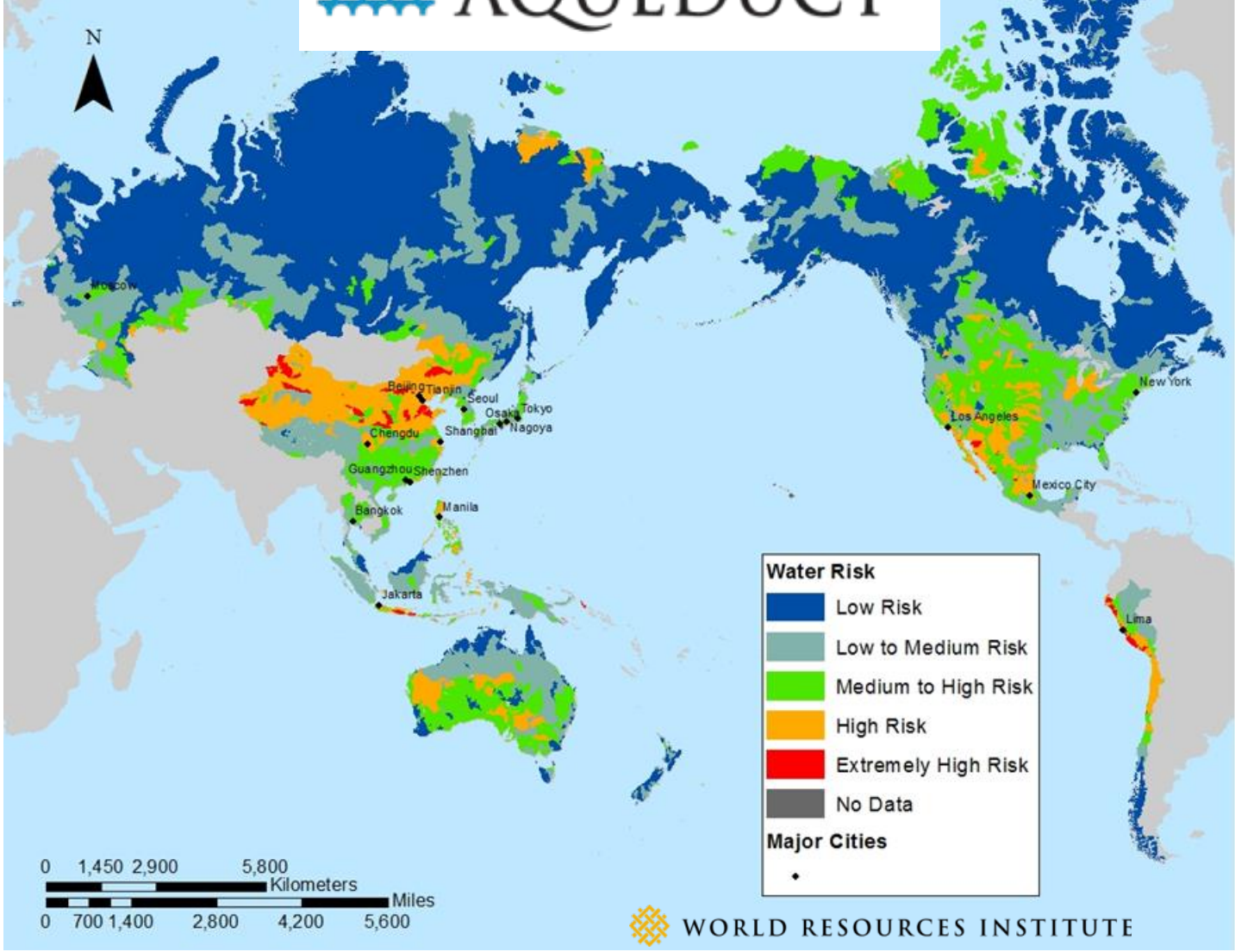
- Water use for thermoelectric production varies by:
 - Withdrawal vs. consumption,
 - Plant/fuel type, and
 - Cooling type.

Water for Energy Extraction and Processing

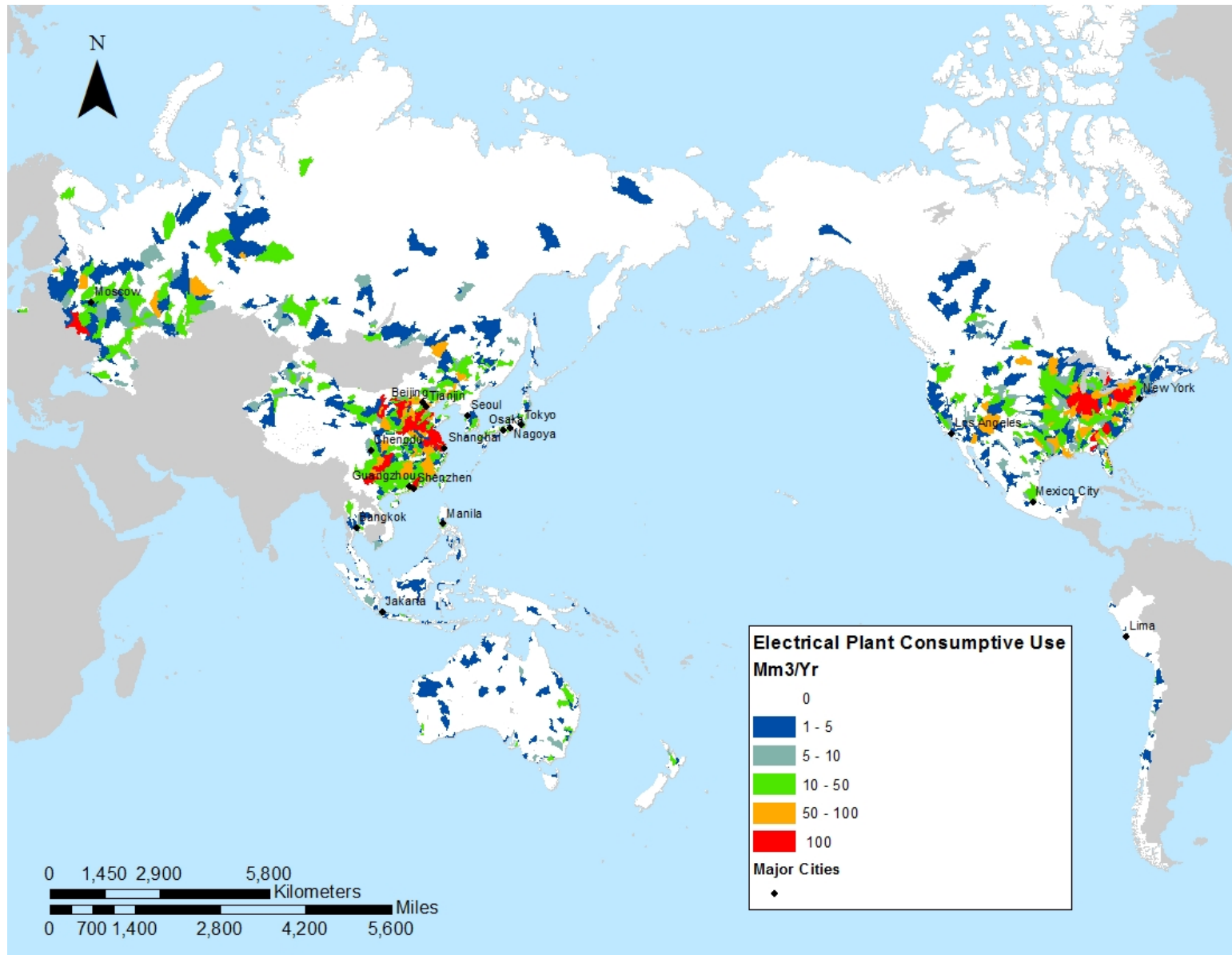


Source: Spang and others 2014

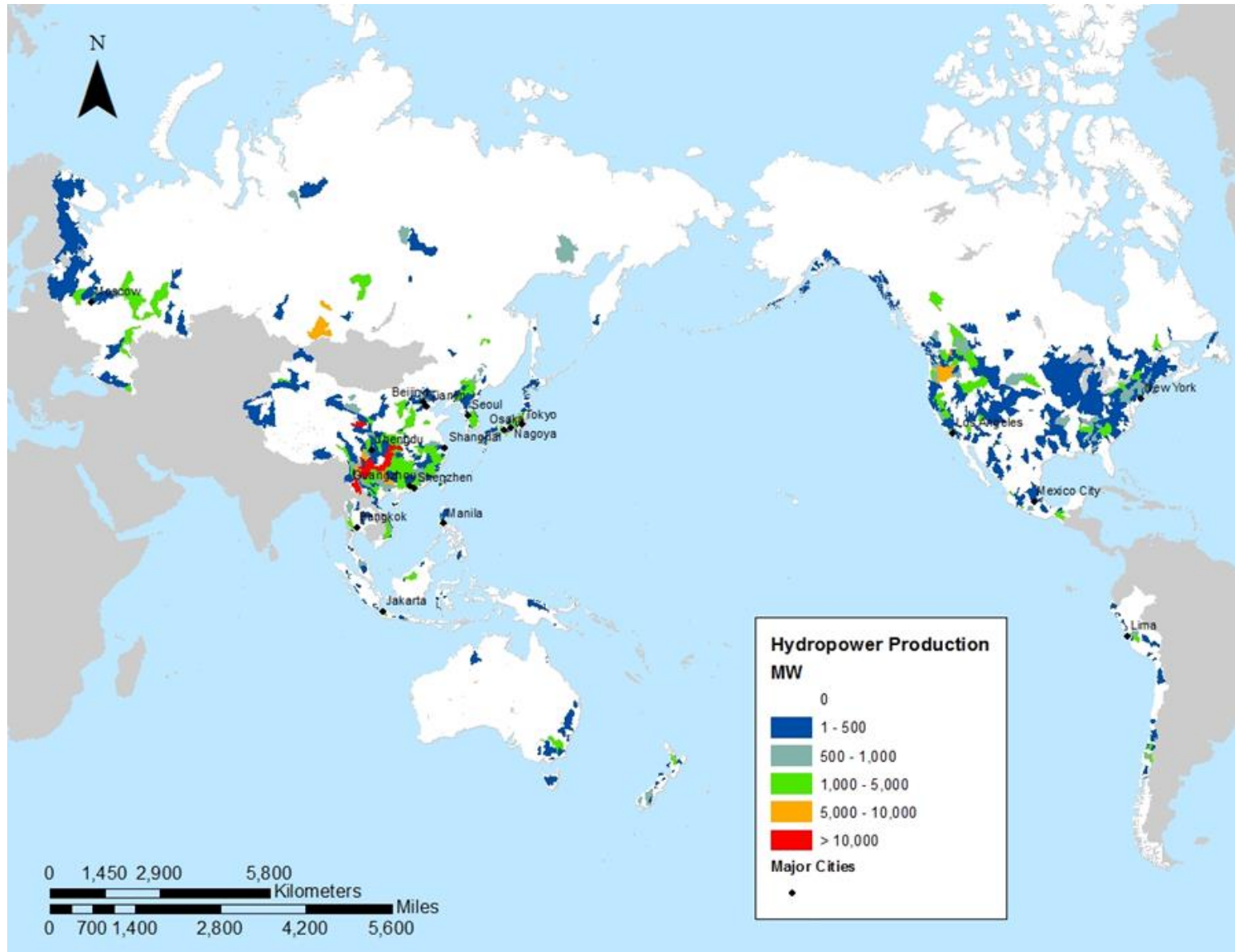
Global Water Risk Mapping



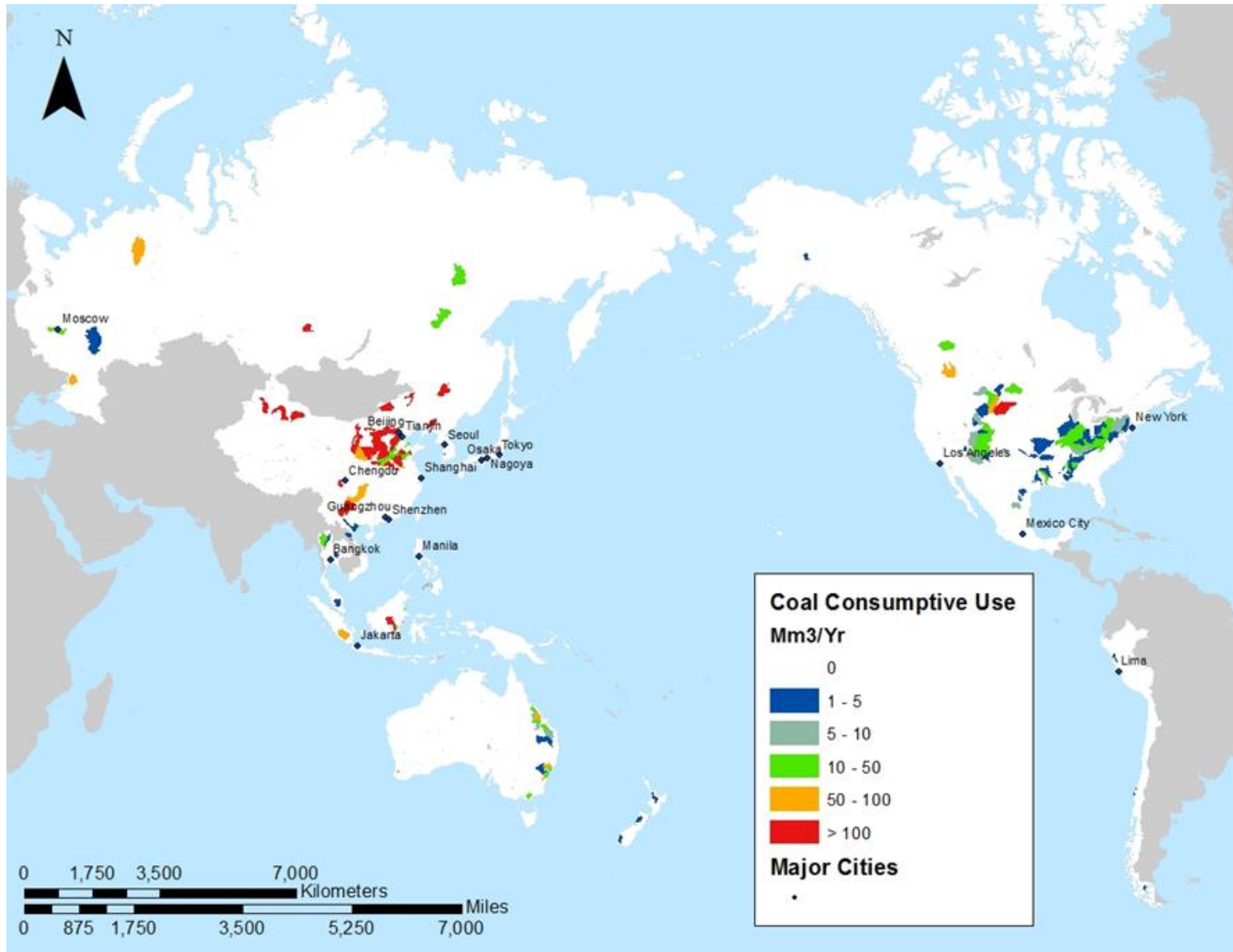
Water for Thermoelectric Power



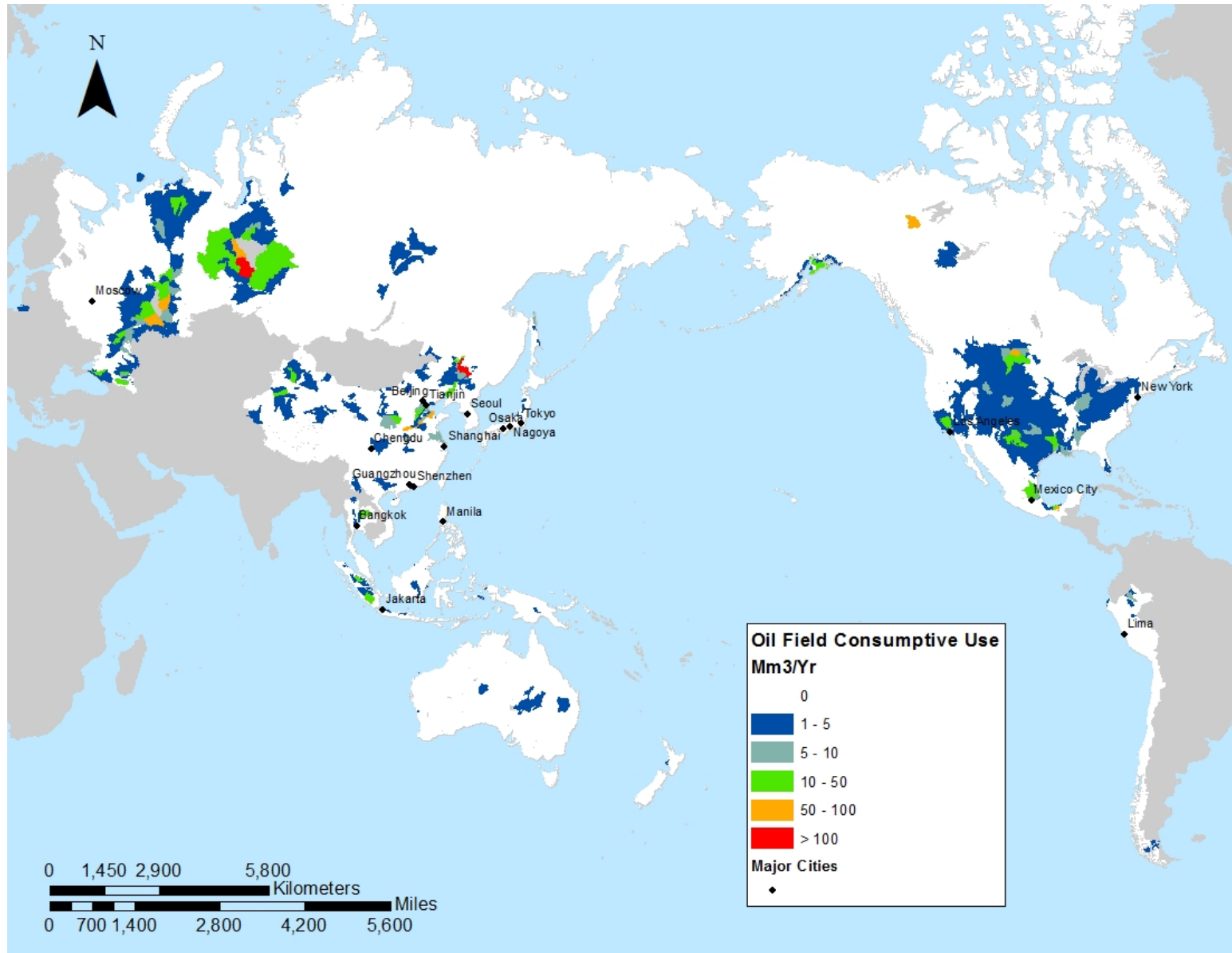
Hydroelectric Power (MW)



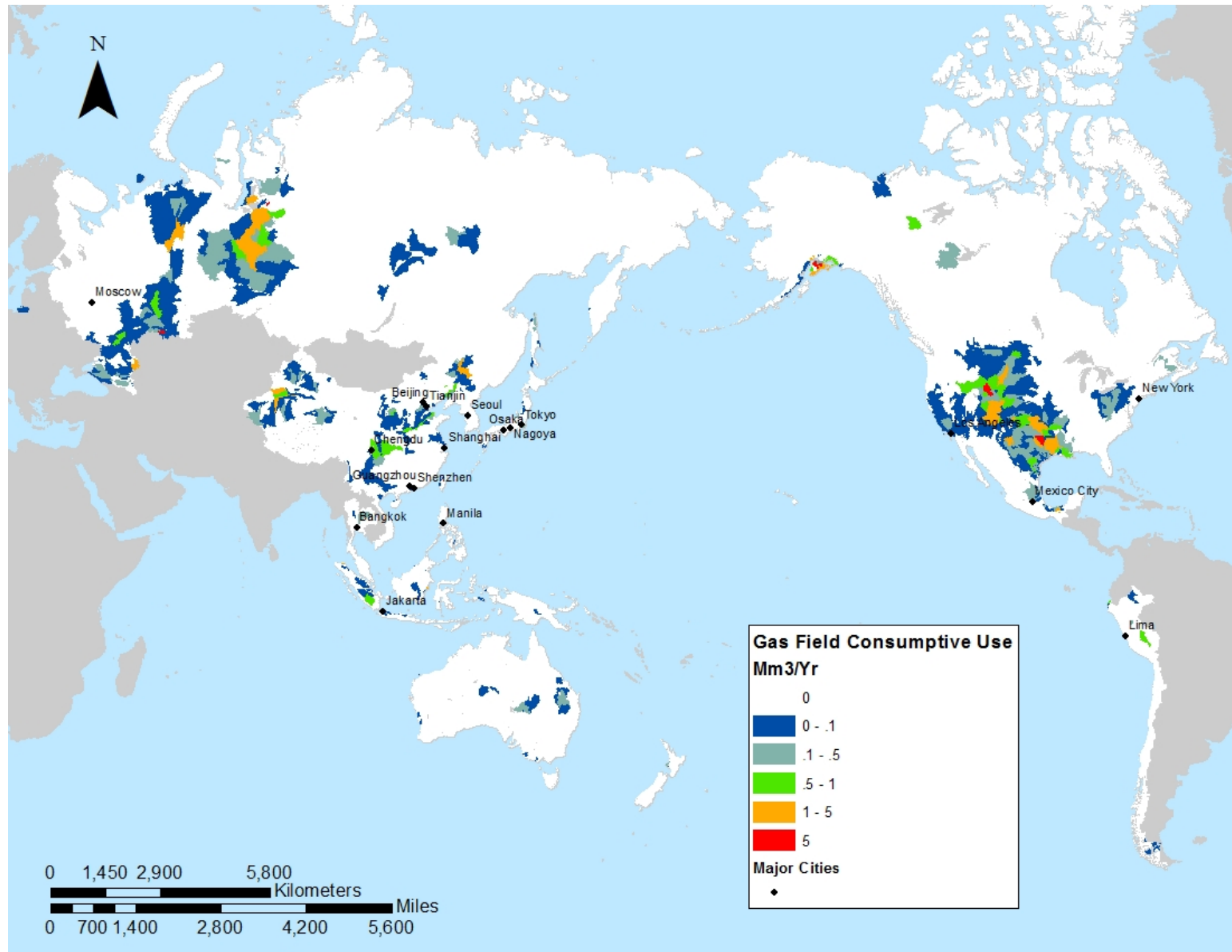
Water for Coal Extraction



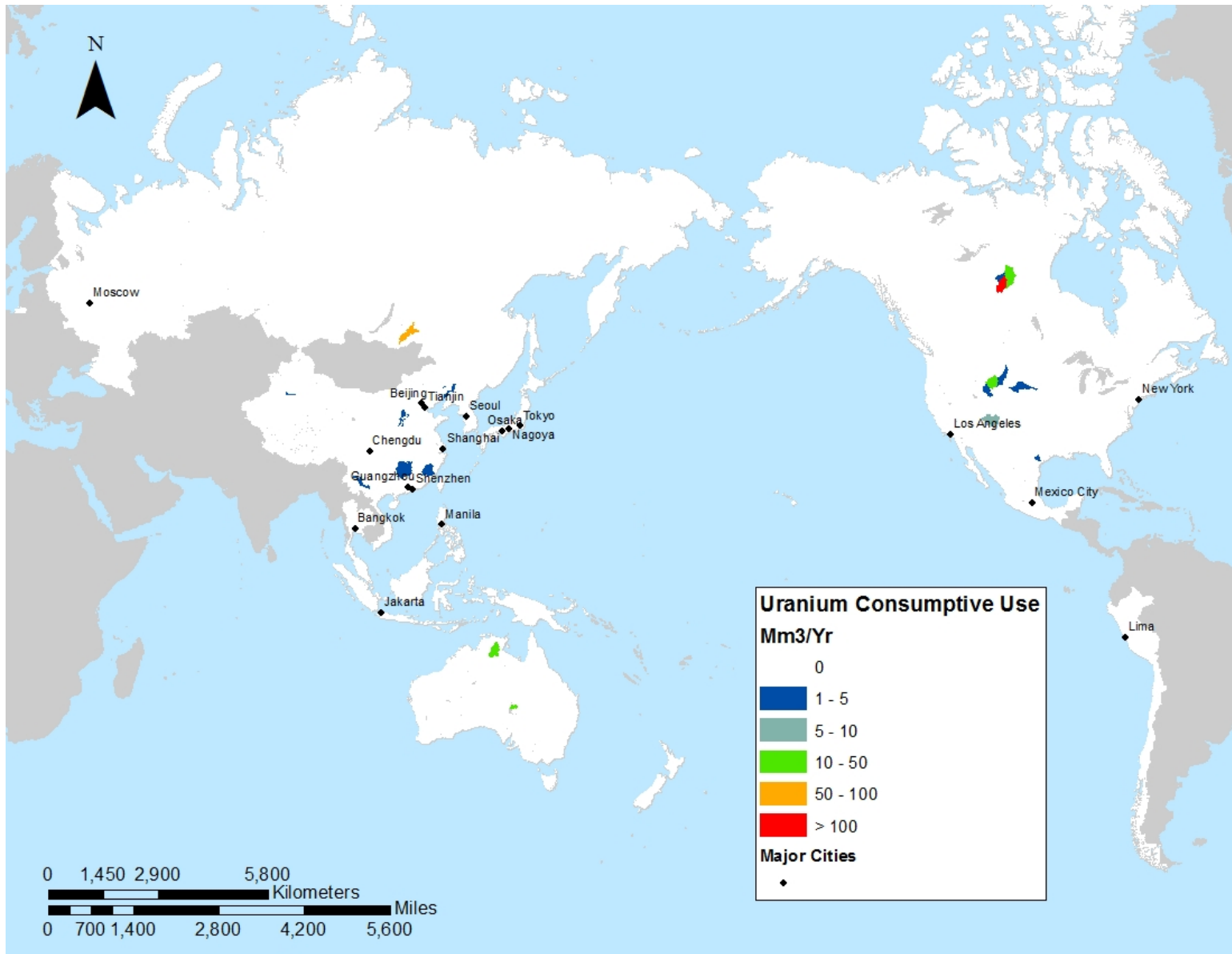
Water for Oil Extraction



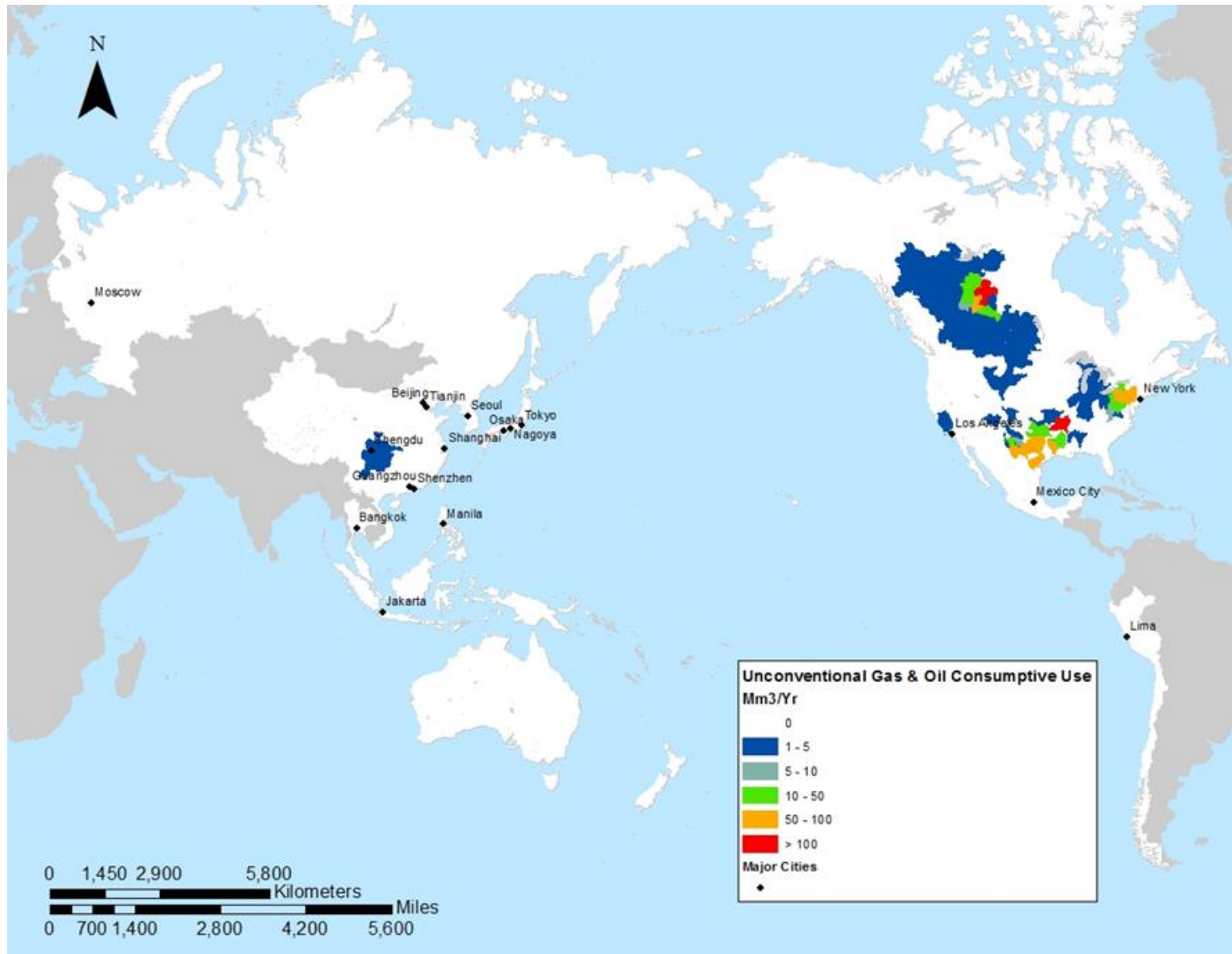
Water for Natural Gas Extraction



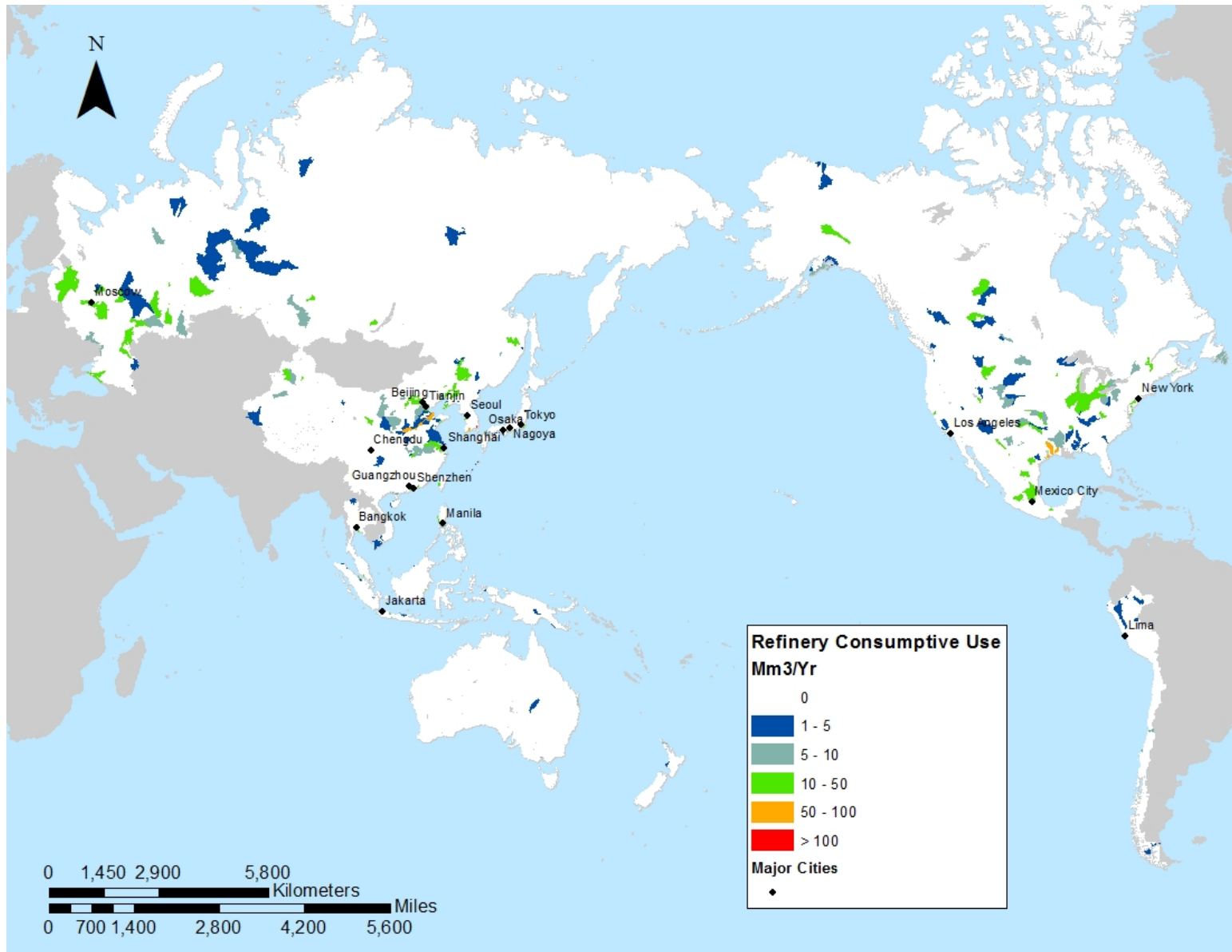
Water for Uranium Extraction



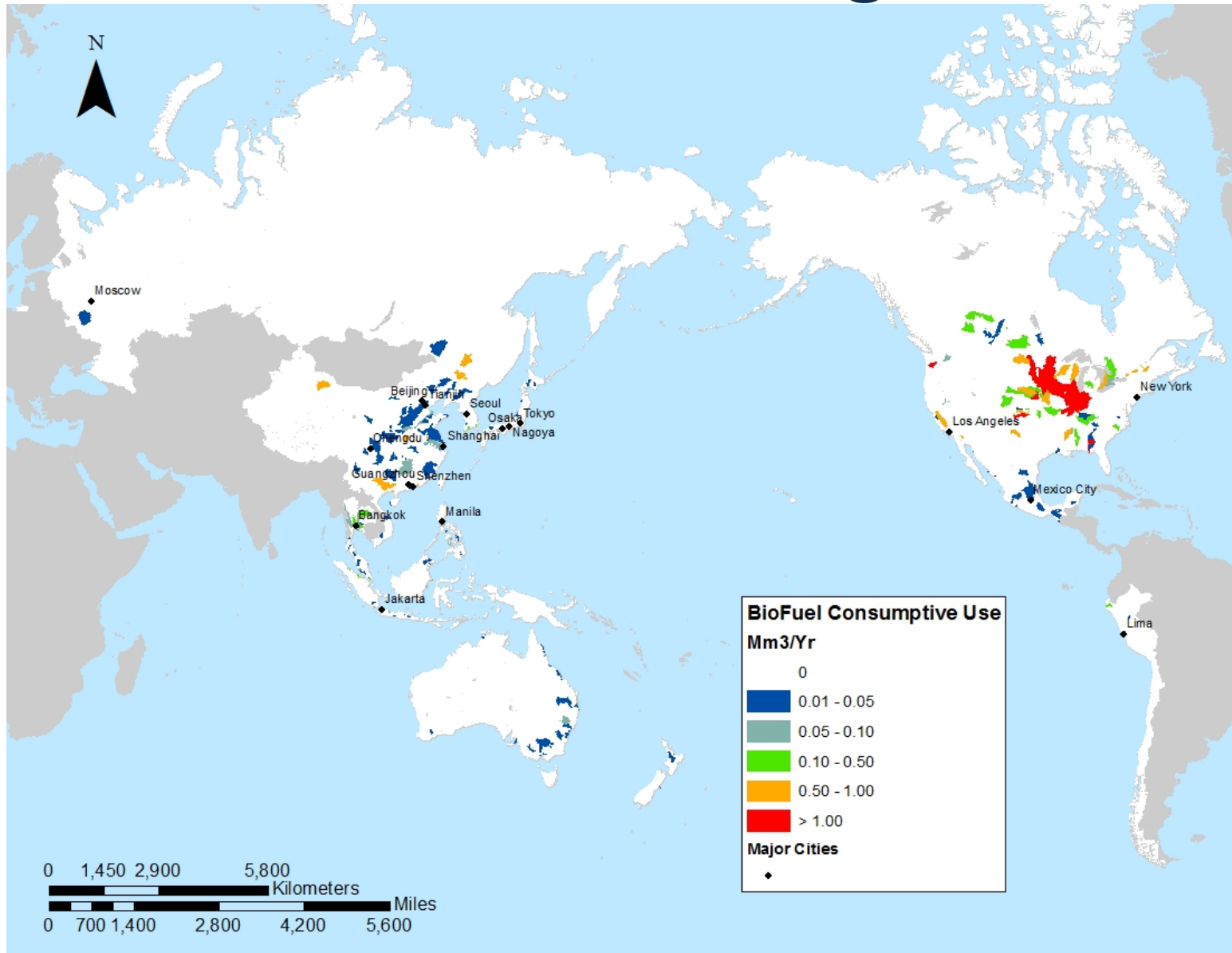
Water for Unconventional Oil and Gas



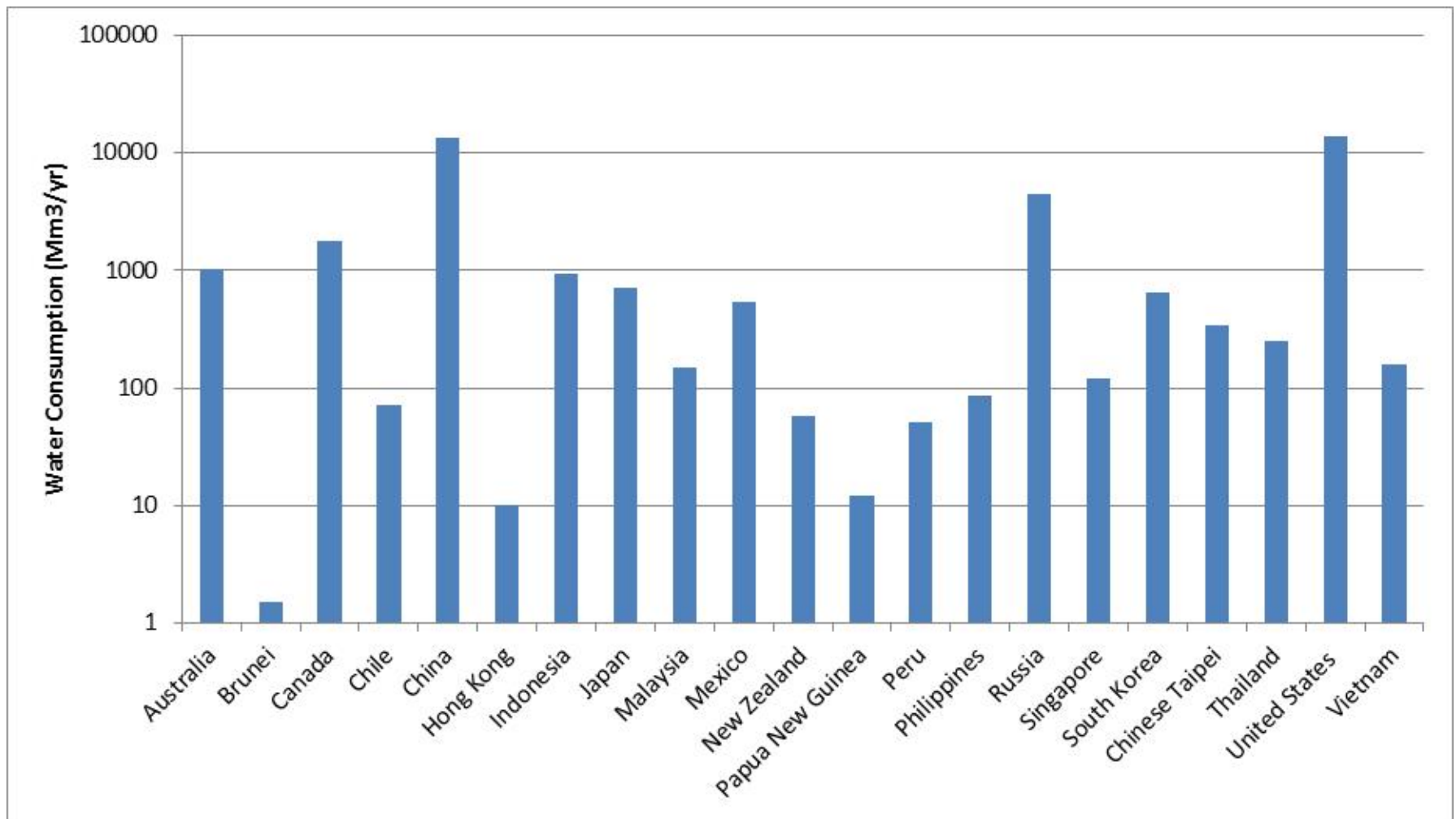
Water for Oil Refining



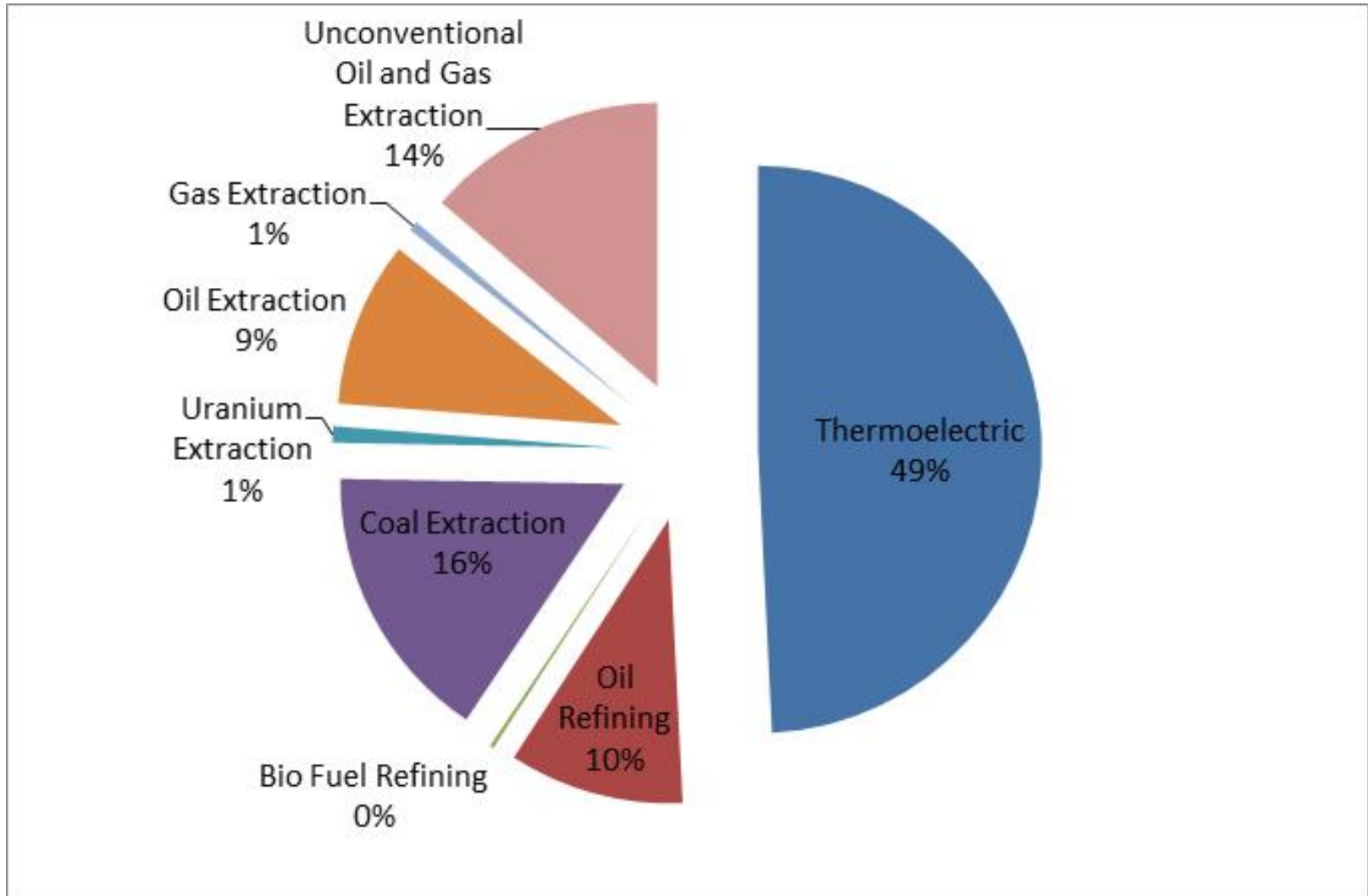
Water for Biofuel Refining



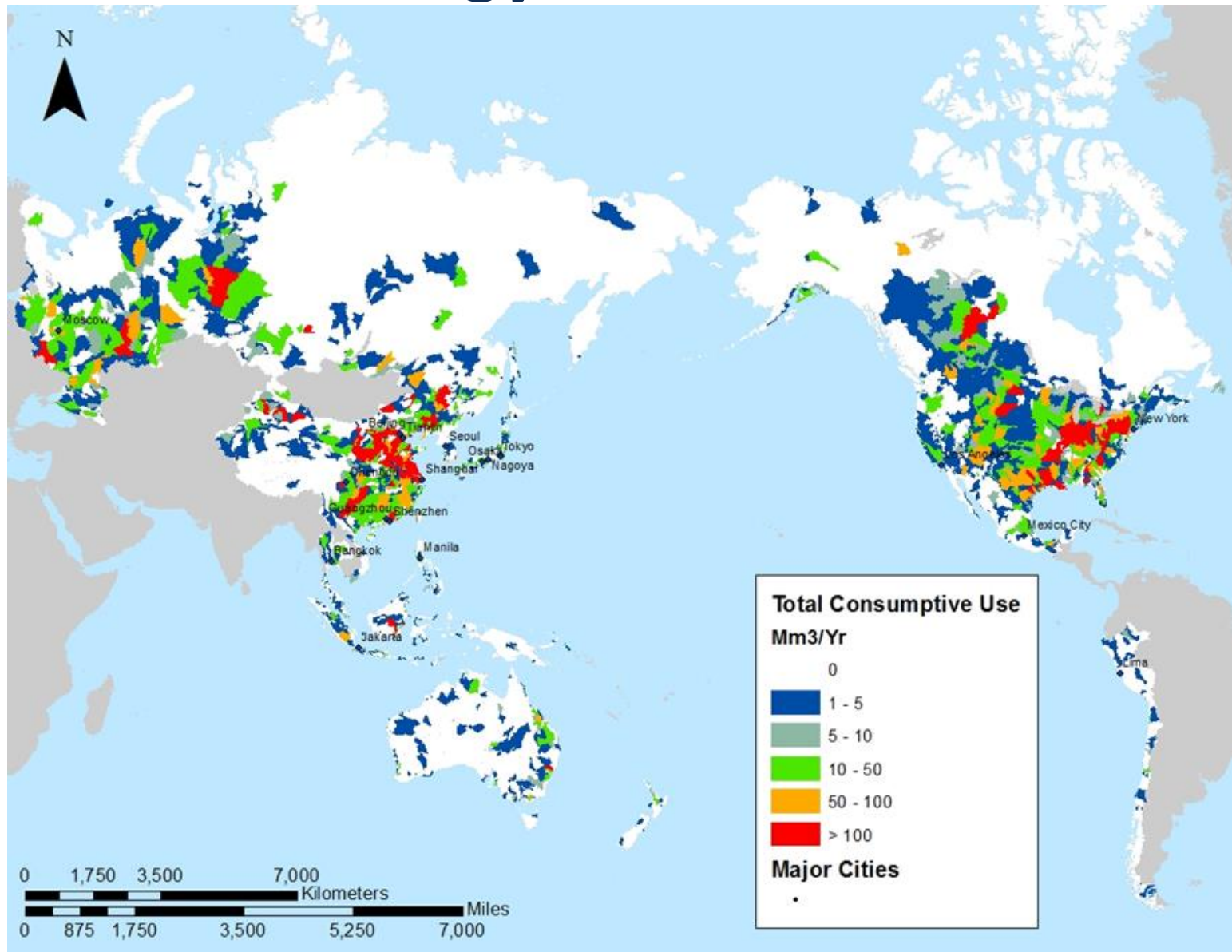
Water for Energy by Economy



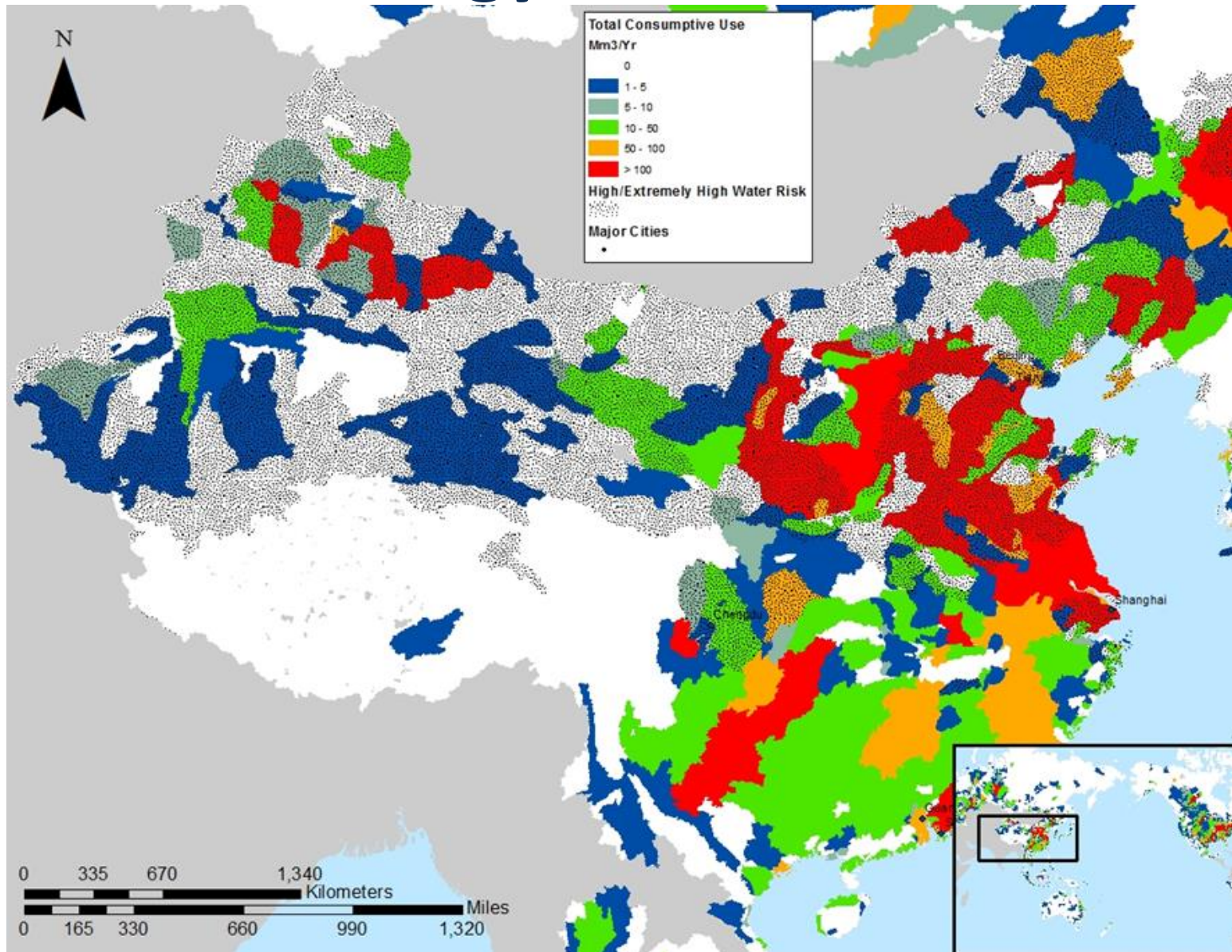
Water for Energy by Sector



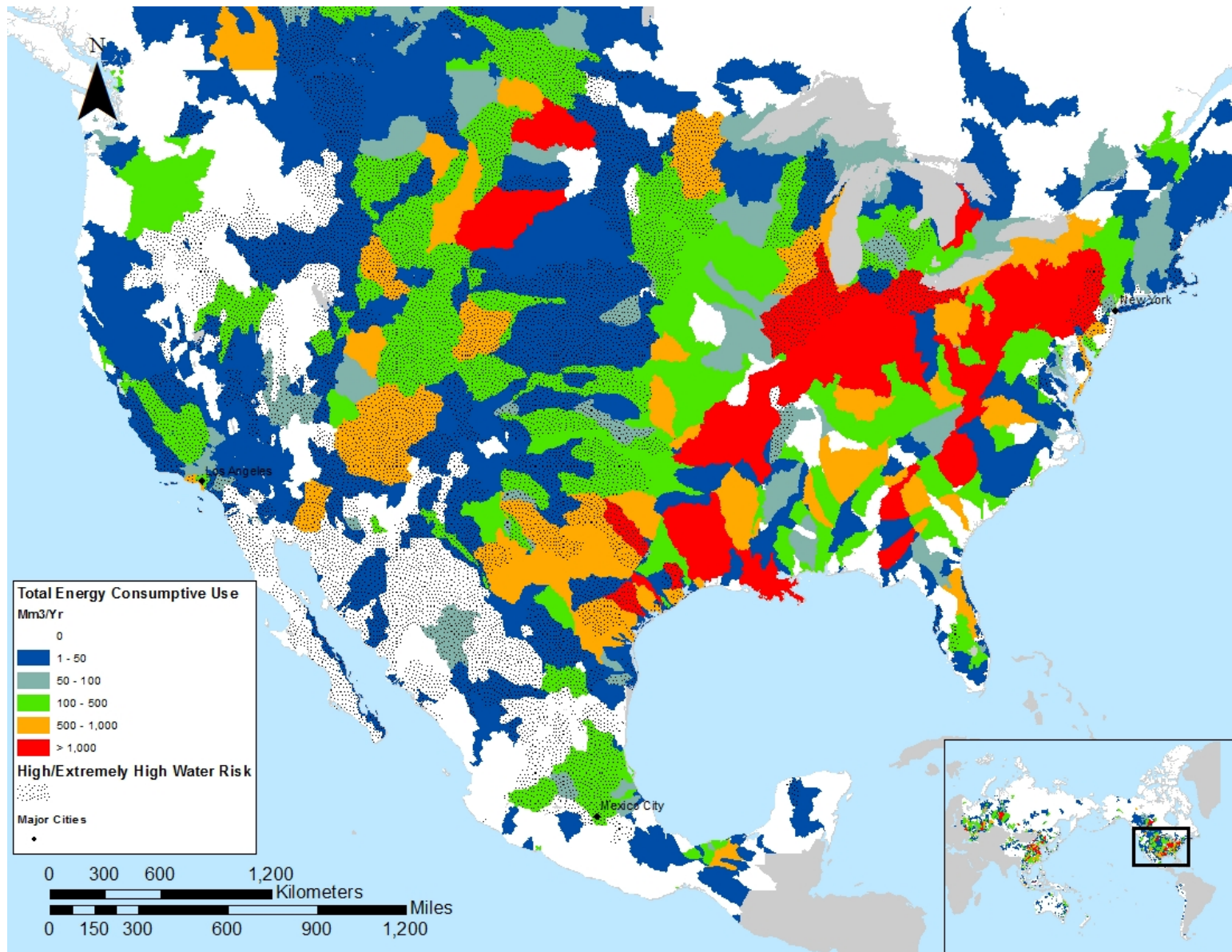
Water for Energy with Water Stress



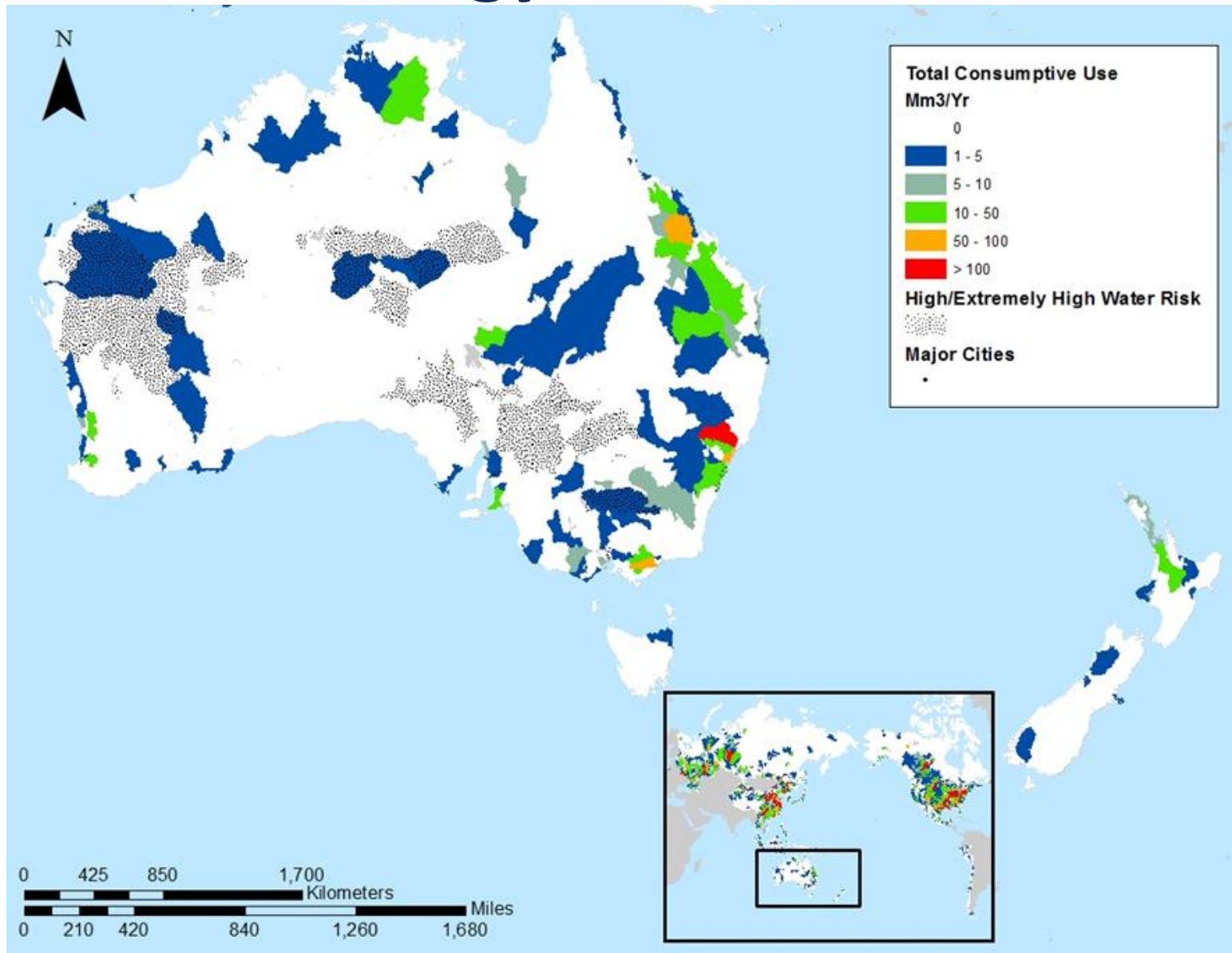
Water for Energy: Detail China



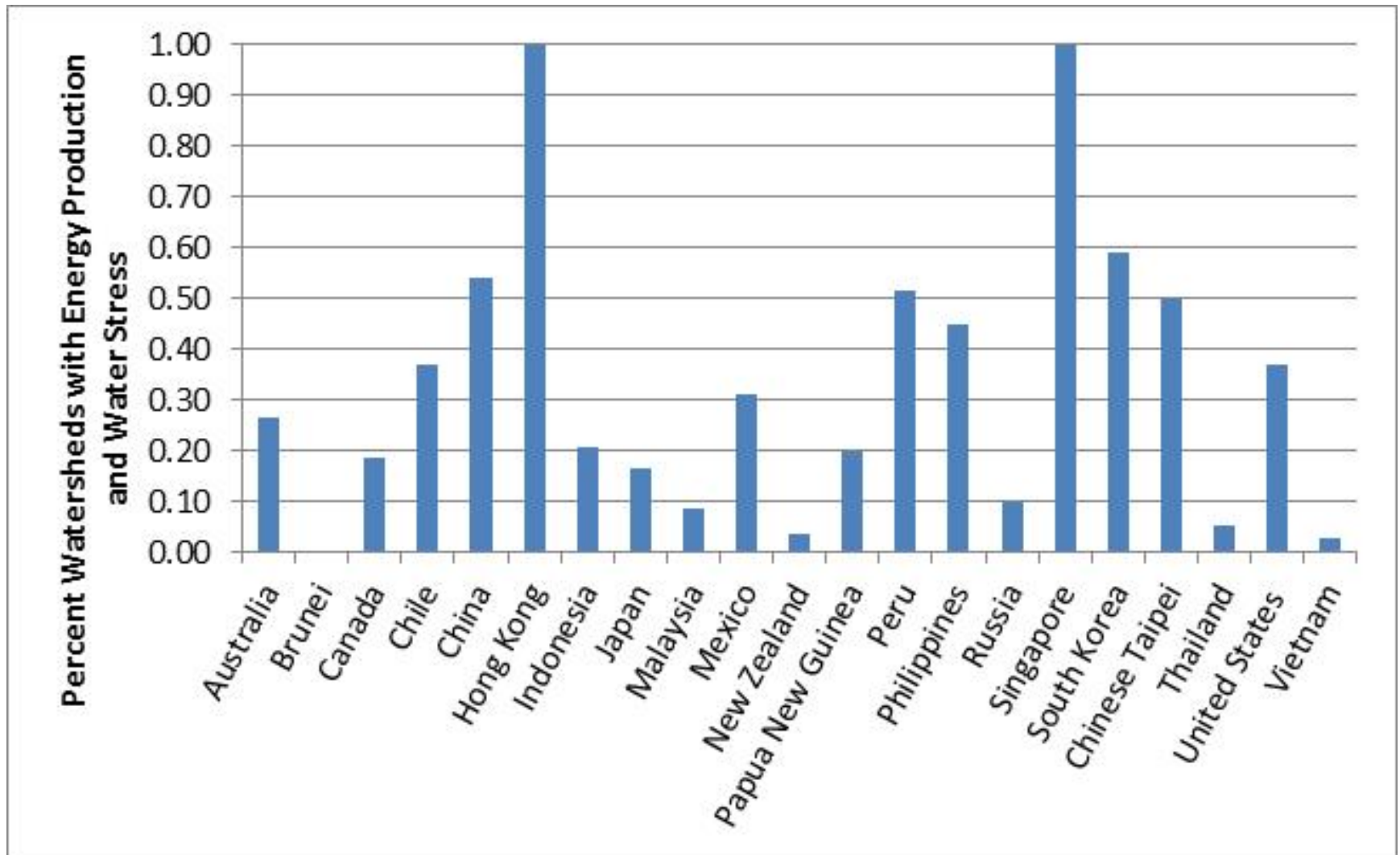
Water for Energy: Detail United States



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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The screenshot shows the Sandia National Laboratories website. The main navigation bar includes 'Energy and Climate' and sub-sections like 'Renewable Systems', 'Climate/Environment', 'Energy Infrastructure', 'Energy Research', and 'About EC'. The current page is titled 'Energy and Water in the Western and Texas Interconnects'. The main content area features an article titled 'Water Scarcity Impacts Energy Production' with a sub-header 'In the United States the energy sector accounts for approximately 41% of daily fresh water withdrawals and 49% of total overall daily water withdrawals for the following energy-related uses:'. Below this are three bullet points: 'Hydroelectric power generation', 'Thermoelectric power plant cooling and air emissions control', and 'Energy-resource extraction, refining, and processing'. There are three images: a power plant, a cooling tower, and a wind turbine. The article continues with a paragraph from the Energy Information Administration and another set of bullet points: 'Limitations of surface-water storage capacity', 'Increasing depletion and degradation of ground water supplies', 'Increasing demands for the use of surface water for in-stream ecological and environmental uses', and 'Uncertainty about the impact of climate variability on future water fresh surface and ground water resources'. At the bottom of the article are social media icons and a 'Last Updated: August 7, 2014' notice. The sidebar on the right contains a 'Water Security Program' section with links to 'Water Infrastructure Security', 'Water, Energy, and Natural Resource Systems', 'Energy and Water in the Western and Texas Interconnects', 'Energy and Water Data Portal', 'Electric Power Generation and Water Use Data', and 'Water Availability, Cost, and Use'. Below that is an 'Energy-Water Data Portal' section with a map of the Western and Texas Interconnects. A 'Go To Top' link is at the bottom right of the page.

The footer of the website features the tagline 'Exceptional service in the national interest'. It is organized into five columns:

- EC:** About Energy and Climate (EC), Energy Security, Climate Security, Infrastructure Security, Energy Research, Key Facilities, Publications.
- EC Highlights:** Sandia Report Presents Analysis of Climate Impacts of SunShot Solar Energy Site; SunShot Wins Award for Best Project at 4th ELEC Photovoltaic Specialist Conference (PVSC); Sandia Contributes Distinguished Analysis of Clean Renewables Project; Company's 100th: Timeline; The Influence of Rotor Blade Design on Wind Development.
- EC Top Publications:** Solar Energy Grid Integration Systems: Final Report of the Florida Solar Energy Center Team (2/4/14) 4.71 MB; Modeling System Losses in PVArray (2/26/14) 265.05 KB; Improved Test Method to Verify the Power Rating of a Photovoltaic (PV) Project (3/19/14) 319.74 KB; Solar Energy Grid Integration Systems: PV Grid Practices - Intelligent Advances for Photovoltaic Systems (2/17/14) 267.26 KB; View all EC Publications.
- Related Topics:** Concentrating Solar Power; CSP: EPRC Energy; Energy Efficiency Energy; Security Infrastructure; Infrastructure: Security National; Solar Thermal Test Facility; NORTH photovoltaic; Photovoltaics PV; Renewable Energy solar Solar; Energy solar power Solar; Research Grid-State; Lighting SSLS.
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