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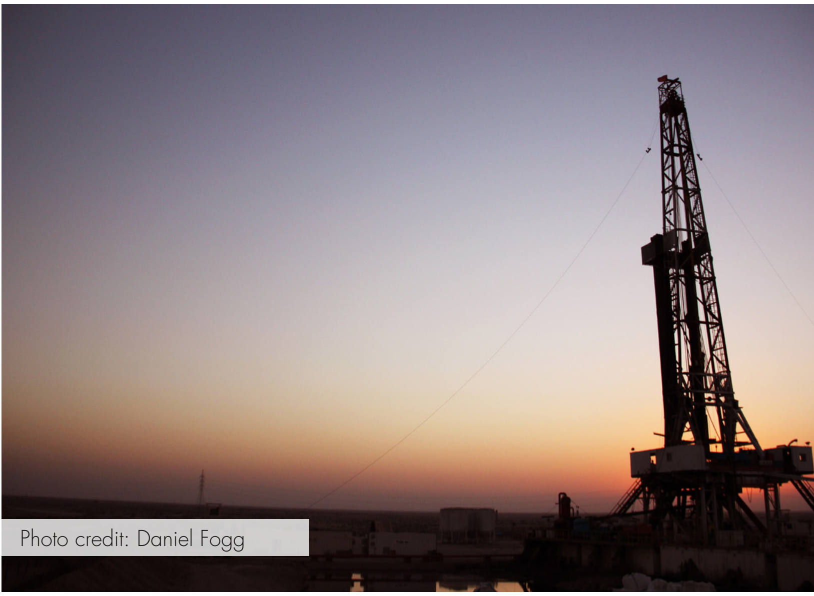
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A THIRST FOR POWER

A Global Analysis of Water Consumption for Energy Production

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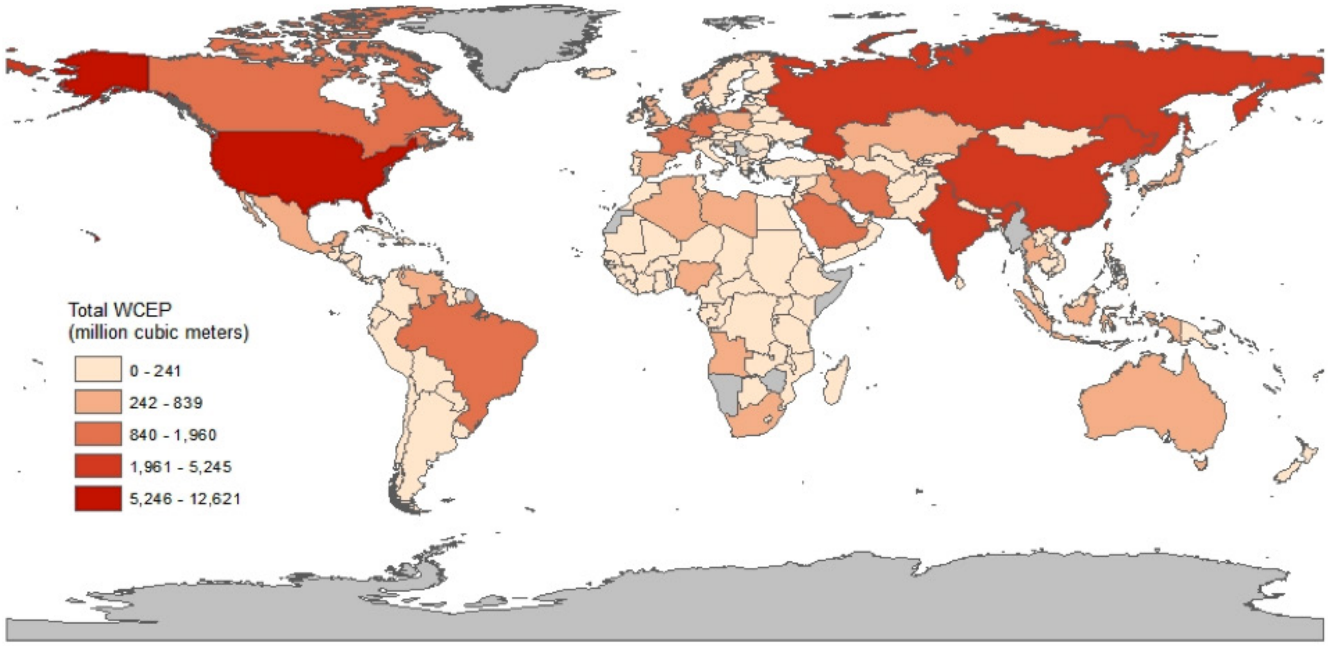
"JUST AS MONITORING GREENHOUSE GAS EMISSIONS IS THE FIRST STEP TO TRANSFORMING ENERGY PORTFOLIOS TO MITIGATE CLIMATE CHANGE, IMPROVED INDICATORS FOR WATER CONSUMPTION IS REQUIRED TO BALANCE THE WATER IMPACTS OF LONG-TERM ENERGY PLANNING."

--EDWARD SPANG, UC DAVIS

Water and energy resource systems are fundamentally interrelated. Secure, reliable access to both resources is critical to basic survival, as well as ongoing economic development, at all scales and in every region of the world. Water is required to make energy, and energy is required to treat and move water—a relationship we call the "water-energy nexus."

As competition for finite freshwater resources intensifies around the world, it is increasingly important to balance the demand for water across multiple sectors while also protecting ecosystems. Understanding the water demand of energy systems is fundamental to overall national water security, since producing energy requires fresh water. While agriculture dominates water demand in many regions of the world, the energy sector has become a major competitor. In the United States, there is a relatively even split between water withdrawals for irrigating crops (40% of total) and for cooling thermoelectric power plants (39%). Further, the division between agricultural and energy-based water demand is no longer straightforward, as irrigated crops are increasingly converted to biofuels.

Given the potential impact of energy policy decisions on regional water security, there are few metrics to help us assess the water burden of national energy portfolios, and a clear estimation of water consumption for complete national energy portfolios at the global scale does not currently exist.



CWEE researchers addressed this knowledge gap by developing a global distribution of water consumption by national-level energy portfolio. We defined and calculated a water consumption for energy production (WCEP) indicator to quantify and compare the water use of 158 national energy systems. WCEP estimates freshwater consumption across all energy categories, including fossil, nuclear, and biofuels, as well as electricity production.

Our research provided an estimate of global WCEP at approximately 45 billion cubic meters of water per year. With significant variability in the WCEP values across the 158 countries that were assessed. In per capita terms, the countries that were heavily producing fossil fuel or biofuels demonstrated greater intensity of energy-based water consumption. These results suggest that the economic imperative to develop fossil fuels drives higher WCEP, even in water-poor countries. Meanwhile, biofuels require so much water that any national commitment to their production has significant water consumption implications.

While these results are based on a comprehensive review of currently available data, future research in this area could be significantly enhanced through better data and widespread adoption of consistent reporting mechanisms. Additional opportunities to expand the field include increasing the resolution of the study regions, characterizing WCEP trends over time, and exploring innovative policy approaches to managing national WCEP effectively.

This research contributes an improved set of metrics to characterize the baseline conditions of integrated water-energy systems. By benchmarking water consumption for energy to standard measures, policy makers can better understand and track the status of this coupled system. Just as monitoring greenhouse gas emissions is the first step to transforming energy portfolios to mitigate climate change, improved indicators for water consumption is required to balance the water impacts of long-term energy planning.

EDWARD SPANG, PH.D.

Dr. Edward Spang is the program manager for the CWEE. His doctoral research focused on the link between water and energy resources at the global level, including the critical importance of improving efficiency in resource use in both sectors. Before joining CWEE, he worked as the Project Coordinator for the MIT-Portugal Green Islands project – an integrated energy system planning effort to design a clean energy future for the Azores archipelago of Portugal.. Previous academic research projects focused on regional case studies of water systems and opportunities for improved water resource management in Central and South America.