

# **A Perspective on Food–Energy–Water Nexus for Net-Zero Urban System**

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Cities are home to 56% of the world’s population today, and the United Nations predicts that this figure will likely rise to 68% by 2050. In many regions of the world, managed urban systems are overtaking natural ecosystems for providing the services and functions upon which societies depend. Consequently, the availability and security of food, energy, and water (FEW) resources are becoming important determinants of urban sustainability including urban geochemical cycles. Advances in science and technology are required to build and maintain the sustainability and geochemical health of urban systems during their decoupling from connected natural processes. However, accelerating population growth and climate change threaten the ability of science and technology to ameliorate the desired urban functions. Currently, limited system-level appreciation of the complex geochemical, economic and sociological feedbacks to the FEW networks hinders the sustainable development of urban systems. The lack of integration of different networks into a systems framework limits the applicability of answers to a specific network to broader problem identification and solution development. This is particularly the case with problems of global significance, such as greenhouse gas emissions, health concerns of aerosol and emerging pollutant transfer and exposure, food safety, and water scarcity and degradation. With mobile societies and interlocking trade agreements, these problems spread beyond a single city and are becoming global in consequence. Recently, governments, foundations, municipalities, and private organizations have treated the FEW nexus as an integrated sustainability topic. The FEW nexus is a complex system of networks with feedbacks and internal resistances that determine urban environmental sustainability while confronting increasing complexity and challenges brought about by supply chain disruption, increasing energy consumption, waste generation, and ecosystem degradation. Far less understood are the FEW outcomes for future cities. The outcomes will influence resource allocation, greenhouse gas emissions, energy and environmental justices, and economic wellbeing in urban communities. This presentation will address the increasing challenges and opportunities, identify knowledge gaps, and discuss how FEW-nexus technologies can help achieve the net-zero goal of urban systems.