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Sustainable food-energy-water nexus reclaiming water, energy and fertilizers from wastewaters for urban agriculture

Population growth and rapid urbanization are placing continued stress on three critical and interconnected resources in the urban environment: food, energy, and water. Food, energy and water sectors interact in several ways. Water is required for energy-related processes such as hydropower, cooling of electric power plants, and fuel production. Energy is needed for wastewater treatment, desalination, pumping groundwater, and for transport of water and food commodities. Water and energy are critical for agriculture and food production. In addition, different land use practices, increased urbanization and weather variability have major impacts on water, energy and agriculture resources. Currently, the FEW nexus in the urban environment is not sustainable because of net input of nonrenewable resources and the associated discharges/emissions.

This paper presents an integrated Photo synthetically Oxygenated Waste-to-Energy Recovery (POWER®) system that affords decentralized urban/agricultural wastewater treatment and simultaneous recovery of net energy, tailored water, and fertilizers for use in food-crop cultivation. The premise of the POWER system is that microalgal systems can be engineered to remove organic carbon and nutrients in wastewaters to discharge standards while generating energy-rich biomass that can then be hydrothermally processed to yield biocrude and nutrients for refinement as fertilizers. Preliminary results have demonstrated ways in which the POWER® system can take advantage of the synergies of the FEW nexus to develop decentralized urban infrastructure for improved sustainability, minimizing net import of external resources to the urban FEW sectors and reducing environmental emissions.

Biography

N Nirmalakhandan holds the Ed & Harold Foreman Endowed Professorship in Civil Engineering at New Mexico State University. His current research is in the area of algal systems for wastewater treatment and biofuel production. His research is funded by the National Science Foundation and the US Department of Energy. He has published more than 100 papers in ISI journals in the field of Environmental Engineering.

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