Connecting the Resource Nexus to Urban Basic Service Provision - Towards an Urban CLEW Model

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One of the great challenges of urbanization worldwide is to ensure reliable and sustainable provision of water and energy to the growing number of city dwellers. Not only does the increased demand for water and energy put pressure on our natural resources, but these resources are also interdependent, and the systems that deliver them to our cities are interlinked (Bazilian et al., 2011).

The nexus between our most crucial resource systems (focused on energy and water; energy, water and food; or climate land-use, energy and water) has gathered increasing attention in recent years, especially in the science-policy interface. Since these resources and the systems that deliver them to cities are often public infrastructure intensive, “nexus-sensitive” policy and planning is crucial to ensure sustainable management of our limited resources.

At the urban scale, improving the resource efficiency at the point of consumption holds the potential to save both energy and water, when the full ‘nexus’ systems interactions are considered. In addition, urban green infrastructure have shown great potential to provide multiple urban services at low or even positive environmental impacts, such as stormwater retention and urban heat island mitigation (NYSERDA, 2012) but are seldom fully assessed based on their multiple benefits.

This study develops an integrated conceptual and quantitative framework that connects the water-energy resource nexus with basic service provision in cities. A pilot case study illustrates how water, energy, cost and climate impacts from a range of hypothetical city-wide interventions in the city of New York could be analyzed and compared in this framework. The interventions studied include:

- a shift to more efficient water- and/or energy-using household appliances;
- an expanded installation of green roofs and;
- an increase in the number of rain barrels for harvesting rain water

By comparing these seemingly very different interventions, and quantifying the relative impact if an equal amount of investment was made in all of them, we aim to assess how resource efficiency, climate mitigation potential and costs of a variety of water and energy dependent urban service technologies can be compared in a single framework.

Results indicate that both resource efficiency gains costs and payback times vary greatly between the compared interventions. A general recommendation to always seek nexus - or multi-resource - efficiency would therefore be blunt guidance for policy makers trying to make the most of their (likely limited) budget. To consider these urban resource interactions sincerely, sophisticated and systematic quantitative assessments of their coupled effects is needed. A fully developed urban resource-to-service nexus framework based on the prototype developed in this study is envisioned to be valuable for such assessments, with capacity to support urban sustainability planning and policy-making, especially for direct comparison of multi-resource benefits of interventions of different nature.