New MARKAL Tool Designed to Help Cities Meet

Environmental Protection Goals

Cities interested in setting sustainability goals to reduce air pollution and protect water quality might want to look at the energy–water connection. While that may seem unusual, it is based on the fact that providing and treating water requires a lot of energy.

City planners often consider providing electricity to residential, commercial, and industrial customers and providing drinkable water and wastewater treatment as separate activities, but examining water and energy consumption and management together can provide insights into ways to become more sustainable and even more resilient to heat waves, heavy rainfall, and other extreme weather events.

That is the goal of U.S. Environmental Protection Agency (EPA) researchers who are creating an energy and water

technology tool—called the Community-Scale MARKAL Model—to help cities and other municipalities make decisions on how to protect the environment, while also providing energy required for water services.

Community-Scale MARKAL Model

This decision-support tool was built using the MARKAL modeling platform that researchers use to model the nation's energy system and evaluate different energy technology options for reducing air quality emissions. The tool taps into energy and water technology data in MARKAL to create future scenarios or options for optimizing water and energy consumption and management. City planners can run simulations on a variety of policy options to evaluate the most cost-effective and environmentally sustainable solutions for providing energy- and water- related services such as heating, cooling, and water and wastewater treatment.

An integrated approach to planning for water and energy services has many advantages, says Ozge Kaplan, an EPA researcher who is leading the project. It can enable cities to make more informed decisions to protect their environment, protect scarce natural resources such as water, reduce costs, and reach long-term goals to reduce their carbon footprint.

"Cities look at energy and water in silos and not always at their interrelationships," says Kaplan. "We hope to develop case studies in collaboration with universities to show how this tool can be applied to solve real-world problems."

For example, a city can evaluate the effectiveness of green infrastructure projects such as green roofs to retain or else detain rainfall during heavy storms before it enters the city's wastewater treatment system. Reducing water runoff during extreme events or on a regular basis can have at least three major implications, both on the water and energy management sides:

- It will reduce energy demand for treating the water, thus reducing the amount of air pollutants emitted in the city, including greenhouse gases that can impact climate change.
- It will keep wastewater treatment plants' use within their capacity, thus avoiding untreated storm and wastewater being discharged directly to nearby streams, rivers, and other water bodies.
- Some studies suggest that building green roofs rather than having black roofs can have a cooling effect on buildings, and thus reduce energy demand for heating and cooling.

In addition to green roofs, there are other alternatives that could influence building energy consumption patterns, such as white roofs, rooftop solar panels, combined heat and power plants, or changes to the energy grid that reduce stress from disruptions in energy and water supplies. However, as with any systems-based changes in infrastructure, holistic impacts of these alternatives need to be considered in turn as each alternative may present the decision-maker with a different set of pros and cons.

In Next Month's Issue…

The Risk Management Plan (RMP) Rule

The U.S. Environmental Protection Agency (EPA) is proposing to amend its RMP regulations. The proposed revisions include enhancements to the emergency preparedness requirements, increased public availability of chemical hazard information, and several other changes to require more analysis and auditing to improve chemical process safety for regulated facilities. This issue will consider the proposed revisions from various stakeholder perspectives.

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Pilot Program: New York City

Kaplan and her colleagues selected New York City as the pilot for developing the tool because the city has a tremendous amount of information collected on water and energy services in building, transportation, and utility sectors. This includes types and quantities of fuels and electricity consumed, greenhouse gas emissions inventories, water consumption, the cost of existing and new advanced technologies expected to be available in the future, and environmental regulatory requirements.

New York City is also an ideal testbed for the tool for other reasons. The city has initiated greenhouse gas reduction goals and other sustainability programs to protect air and water quality for its residents. It also faces challenges to meeting water and energy demands, including population growth, an aging water infrastructure, increased ambient temperatures aggravated by urban heat islands in the summer, and the threat of flooding such as what happened during Hurricane Sandy in 2012 that led to untreated stormwater and wastewater being discharged into the Hudson River.

Currently, the MARKAL tool contains only information for New York City and the surrounding region. Ozge says her long-term goal is to make it available for use by other cities that could input their unique data and use the scenario building features to evaluate the energy-water connection in their city.

Kaplan met with New York City planners, including those in the city's Office of Long-Term Planning and Sustainability and colleagues in EPA's Regional Office, headquartered in the city, to present plans for the research project. Their collaboration has been instrumental to the development of the prototype database, she says.

Kaplan's goal is to work with city universities to create academic hubs where the tool can be tailored for specific case studies while providing educational development opportunities for students. Their contributions can help to beta test the tool and provide information for how it can be applied for decision making by cities, she says.

Public Release

The Community-Scale MARKAL Model is expected to be ready for public release in early 2018. Kaplan recently presented the work in a paper entitled, "An Integrated Approach to Water & Energy Infrastructure Decision-Making Using the MARKAL Framework: A Case Study of New York City," at a conference by the American Council for an Energy Efficient Economy, and said she received a lot of interest. The paper is published in the online conference proceedings (http://aceee.org/files/proceedings/2016/data/index.htm). **em**

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