

Integrating the WEAP and LEAP systems to support planning and analysis at the water-energy nexus

Geographical focus:	Global, with first application in California, USA
Partners:	National Center for Atmospheric Research, California Department of Water Resources, California Energy Commission
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The water-energy nexus

Water and energy systems have historically been treated as separate realms, with little consideration of one in the planning of the other, and little discussion of interactions between the two. Yet in reality, they are closely interlinked. Water is needed in the vast majority of global energy production systems – for fuel extraction and processing, in hydropower production, and for power-plant cooling, among other uses. And energy is essential for pumping, treating and distributing water.

Efforts to address climate change have heightened awareness of these linkages – the “water-energy nexus” – and of the need to integrate water and energy planning and decision-making. A great deal of this has to do with water scarcity: in many places, conflicts are arising between water demand for energy production, for urban use, for agricultural irrigation, and to support environmental systems. At the same time, energy demand from the water sector – especially for irrigation, but also for desalination and water and sewage treatment – has emerged as a real concern; not only can it strain already overtaxed energy systems, but it also adds significantly to greenhouse gas emissions.

Yet even as recognition of these issues has grown, a lack of suitable tools has hindered efforts to address key questions at the water-energy nexus. This project takes two software systems used by thousands worldwide for water and energy



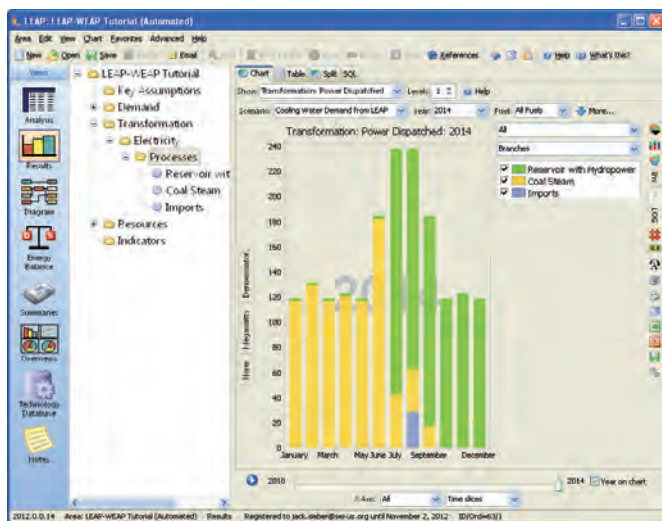
Montana – Kerr Dam ©Flickr/gaby53mt

analysis, and connects them so they can be used together for integrated research, planning and decision-making. We chose this approach rather than building a new tool because we believe it better meets the needs of users in both realms, allowing them to keep working with familiar, well-proven systems, and not have to evaluate and learn new software.

The tools: WEAP and LEAP

Since the early 1990s, the Stockholm Environment Institute’s U.S. Center has offered sophisticated water and energy planning tools free of charge to governments, nonprofits and researchers in developing countries (and for a modest fee to all others). These tools, which are under continuous improvement, help decision-makers at all levels to evaluate their options, explore different socio-economic, development and climate scenarios, and understand difficult tradeoffs. Their well-established user groups make them strong platforms for the development of an integrated water-energy assessment tool:

- The Water Evaluation And Planning (WEAP) system is used in 170 countries around the world to model the balance between water demand and supply at a range of spatial and temporal scales. WEAP models both water demand – and its main drivers – and water supply, simulating real-world policies, priorities and preferences. It has been used to evaluate the impact of a wide range of potential water management measures, from conservation to wastewater reuse, and to plan for adaptation to climate change.
- The Long-range Energy Alternatives Planning (LEAP) system, used in more than 190 countries, is a powerful, versatile software system for integrated energy and GHG



A WEAP ‘reality check’ on hydropower in LEAP:

The bars show the demand for hydro as calculated by LEAP; the green areas show how much can actually be generated, based on water supply data from WEAP.

mitigation planning. It is becoming the de facto standard for countries undertaking mitigation assessments and creating Low Emission Development Strategies (LEDs), and has been used for several National Communications on Climate Change to the United Nations. In addition, LEAP has been applied to develop climate strategies for several U.S. states and cities, and it was recently used to build scenarios for a global energy assessment.

Individually, both LEAP and WEAP already addressed some aspects of water and energy planning, respectively. For example, LEAP could model hydropower, but it did not consider water scarcity as a possible constraint. WEAP, meanwhile, could calculate how hydropower potential might change under different water supply and demand scenarios, but was unable to explore how hydropower fits within a larger energy system.

Integrating WEAP and LEAP

With funding from the U.S. National Oceanic and Atmospheric Administration (NOAA), SEI has now integrated WEAP and LEAP to address these limitations. Each still remains a separate tool, but with a common “wizard” that connects them seamlessly. Thus WEAP and LEAP can now exchange key model parameters and results, such as hydropower generated or cooling water requirements, and together they can represent evolving conditions in both water and energy systems.

Using both systems together, planners can now explore how individual water or energy management choices ripple through both the water and energy systems, understanding tradeoffs that might not be apparent when looking at either system alone. They can then evaluate outcomes against their policy goals and priorities: to supply enough water for all, to reduce GHG emissions, etc. If one approach leads to unacceptable results, they can explore alternative policies and measures.

Real-world applications

Both WEAP and LEAP are used at different scales and under many different sets of circumstances. Here we offer a brief example for illustrative purposes.

Learn more and get started with WEAP and LEAP

WEAP and LEAP are available free of charge to all government, academic and not-for-profit organizations in developing countries. Affordably priced licenses are available to all other users.

To learn more about WEAP, obtain a license, and download the software, visit www.weap21.org. To do the same with LEAP, visit www.energycommunity.org. Each tool has to be installed separately before they can be used together. Detailed support materials are available on the two websites; there are also online forums where users can ask questions, exchange ideas and get help.

Both tools are transparent and user-friendly but most users will require training. Analyses will typically need the participation of experts drawn from both sectors. SEI welcomes the opportunity to provide technical support and capacity-building and to collaborate on policy and planning applications.

Imagine being the water planner for a major metropolitan center in a sunny, dry region. A growing population, a warming climate and heightened competition for water among users make it prudent to seek new water sources. Desalination may seem like a viable option, and WEAP and LEAP can be used together to explore the idea.

WEAP can help gauge how new supplies would fit with the region’s future water needs – and whether the benefits are great enough to justify the cost. LEAP will show the impact on energy demand, for desalination itself and for pumping. If demand increases significantly, LEAP can help you explore options for meeting that demand. To minimize GHG impacts, you might consider using a renewable energy source, such as concentrating solar power. But many CSP technologies are water-intensive; WEAP would help you determine how much water would be needed. This, in turn, could affect how much water needs to be desalinated to meet demand in your region. Such is the cycle of exploration and discovery that the integrated WEAP-LEAP platform enables.



United Arab Emirates – Desalination plant @Flickr/cacti

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